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IDENTIFICATION OF SUBMERGED SIDE SCAN SONAR AND MAGNETIC TARGETS NAVAL STATION PASCAGOULA, MISSISSIPPI

FINAL REPORT

June 2001

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**Michael C. Krivor
Principal Investigator and Author**

June 2001

ABSTRACT

From January 16-24, 2001, archaeologists from Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted an intensive remote-sensing refinement survey and diver investigations of three magnetic anomalies and six sidescan targets located within Pascagoula Harbor, Jackson County, Mississippi. The purpose of the survey was to determine if any of the anomalies represent potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Performed under subcontract to the Louis Berger Group, Inc., of Washington, D.C., the project was conducted for the U.S. Army Corps of Engineers (USACE), Mobile District relative to their responsibilities under Section 106 of the National Historic Preservation Act.

The project area is located in Pascagoula Harbor between Singing River Island and Ingalls Shipyard, Jackson County, Mississippi. A magnetometer and sidescan sonar survey completed of the area in May 2000 (McGehee et al. 2000) identified nine potentially significant targets within the project area. These previously located anomalies were the focus of the current investigation.

Results from the magnetometer and sidescan sonar refinement survey and diver investigation successfully relocated and identified eight of the nine anomalies as presented in McGehee et al. (2000). The one target which was not reproducible (sidescan sonar Target 76A) was absent at its respective coordinates owing to shrimp trawling activity, environmental conditions or as a result of the misinterpretation of the original data. All of the remaining eight targets were identified as modern debris (i.e., wire cable, 55 gallon drum) and are not considered significant submerged cultural resources. Therefore, any subsequent activities concerning the proposed dredging activities of Pascagoula Harbor will not impact any historically significant watercraft.

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INTRODUCTION

From January 16-24, 2001, archaeologists from Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted an intensive remote-sensing refinement survey and diver investigations of three magnetic anomalies and six sidescan targets located within Pascagoula Harbor, Jackson County, Mississippi. The purpose of the survey was to determine if any of the anomalies represent potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Performed under subcontract to the Louis Berger Group, Inc., of Washington, D.C., the project was conducted for (and funded by) the U.S. Army Corps of Engineers (USACE), Mobile District (on behalf of the U.S. Navy) relative to their responsibilities under Section 106 of the National Historic Preservation Act, under Contract No. DOCA01-99-D-0039, Delivery Order No. 0004.

As an agency of the Federal Government, the Corps has been entrusted with the protection and preservation of all cultural resources that may be adversely affected by their project activities. Therefore, they are responsible for determining if any properties within the current project area are eligible for listing on the NRHP prior to the implementation of their project activities. The Federal statutes regarding these responsibilities include Section 106 of the National Historic Preservation Act of 1966 (PL 89-665), as amended; the National Environmental Policy Act of 1969 (PL 91-190); Executive Order 11593; the Archaeological and Historic Preservation Act of 1974 (PL 93-291); and the Abandoned Shipwreck Act of 1987 (PL 100-298). In fulfilling these responsibilities the Corps initiated a cultural resources survey of the project area in order to identify historically significant properties potentially eligible for NRHP listing.

Personnel involved with the investigation included remote-sensing specialists and underwater archaeologists from Panamerican, the *Manana*'s boat captain and mate, as well as the USACE Dive Safety Officer. For a complete list please refer to the Personnel section outlined in the Methods chapter of this report.

The project area is located in Pascagoula Harbor between Singing River Island and Ingalls Shipyard, Jackson County, Mississippi (Figure 1). A magnetometer and sidescan sonar survey completed in May 2000 (McGehee et al. 2000) identified nine potentially significant targets within the project area. These previously located anomalies were the focus of the investigation.

The current anomaly relocation and assessment investigation commenced with a remote-sensing refinement survey which included the implementation of those tools useful in determining the absence/presence of submerged cultural remains within the project area. The remote-sensing equipment used included a magnetometer, sidescan sonar, fathometer, and a Differential Global Positioning System (DGPS). A buoy was dropped at the coordinates of each target located by McGehee et al. (2000). The magnetometer or sidescan sonar was then deployed and a series of refinement lines were run over each of the target areas. Magnetometer data for the three targets was collected for the production of magnetic contour maps to be presented within the report.

For the magnetic targets an additional refinement buoy was placed close to the target for relocation purposes if necessary. A diver was then deployed to locate and identify the source of each magnetic anomaly. If the target was not exposed on the ocean bottom, a probe was then used to delineate any buried anomalies. Once located and identified each target was then sufficiently recorded for report and project purposes. For the remaining six targets, a buoy was deployed on the reported location and a series of refinement runs made over each target area with the sidescan sonar. Sufficient data was collected at each location to identify any potential targets. Regardless of the findings from the sidescan sonar refinement, a diver was placed on each target location to sweep the bottom in an effort to identify any targets within the area.

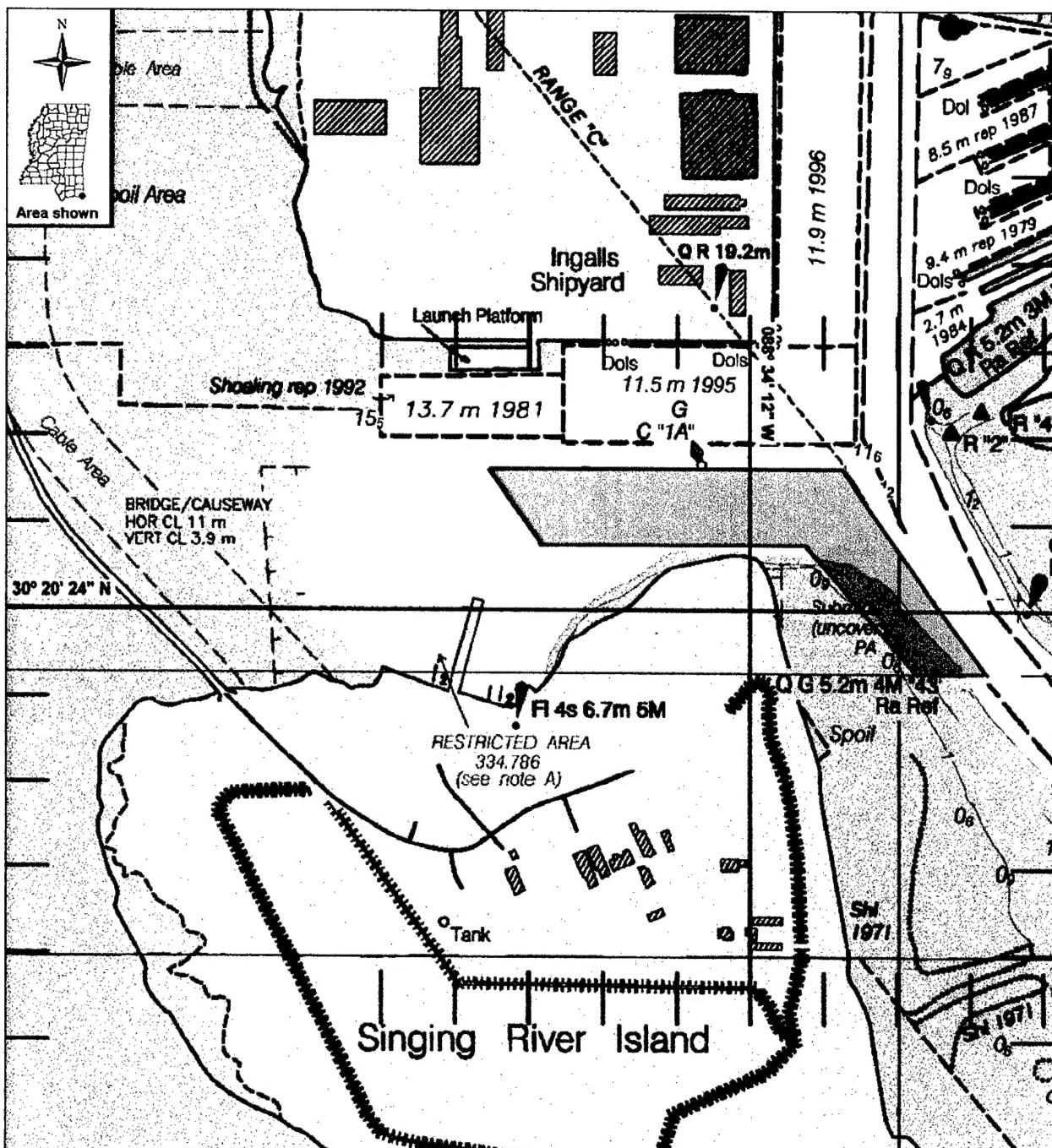


Figure 1. Project area location (base map: NOAA Chart No. 11375, Pascagoula Harbor, Mississippi). Study area is shown in red; scale is 1:20,000.

Results from the magnetometer and sidescan sonar refinement survey and diver investigation successfully relocated and identified eight of the nine anomalies as presented in McGehee et al. (2000), while one target (76A) was no longer present at its prescribed location. Target 76A was absent at its respective coordinates owing to shrimp trawling activity, environmental conditions or as a result of the misinterpretation of the original data. The remaining eight targets were identified as modern debris (i.e., wire cable, 55 gallon drum) and are not considered potentially significant submerged cultural resources. Any subsequent activities concerning the proposed dredging activities of Pascagoula Harbor will not impact any historically significant watercraft.

PREVIOUS INVESTIGATIONS

Review of previous investigations indicates that there have been a number of archaeological research projects along the Gulf Coast pertaining to submerged cultural resources. Prior to 1983 no maritime investigations had taken place in Pascagoula Harbor. While numerous surveys have been completed along the Gulf Coast (Hudson 1973, 1981) only one directly involves Pascagoula Harbor. Conducted in 1983 by OSM Archaeological Consultants, Inc. (OSM) the survey included a cultural and maritime history of Pascagoula, a summary of watercraft types in the area, a shipwreck inventory, as well as both terrestrial and underwater survey components. More specific to this survey, OSM located over 500 anomalies (Mistovich et al. 1983).

There are several ways in which this study is relevant to the current project. Part of the current project area overlaps survey areas D and G in Mistovich et al. (1983:100; Figure 2). In these areas, the 1983 survey located 110 anomalies in area D and eighteen anomalies in area G. About half of these anomalies are identified as debris, pipelines, cables, piers, or harbor buoys. The rest of the anomalies (65) range in strength from six to 180 gamma, and are listed as unknown. However, there is no reliable positioning information included with the report, so no direct correlations can be made to modern anomalies or wreck sites located in the current project area.

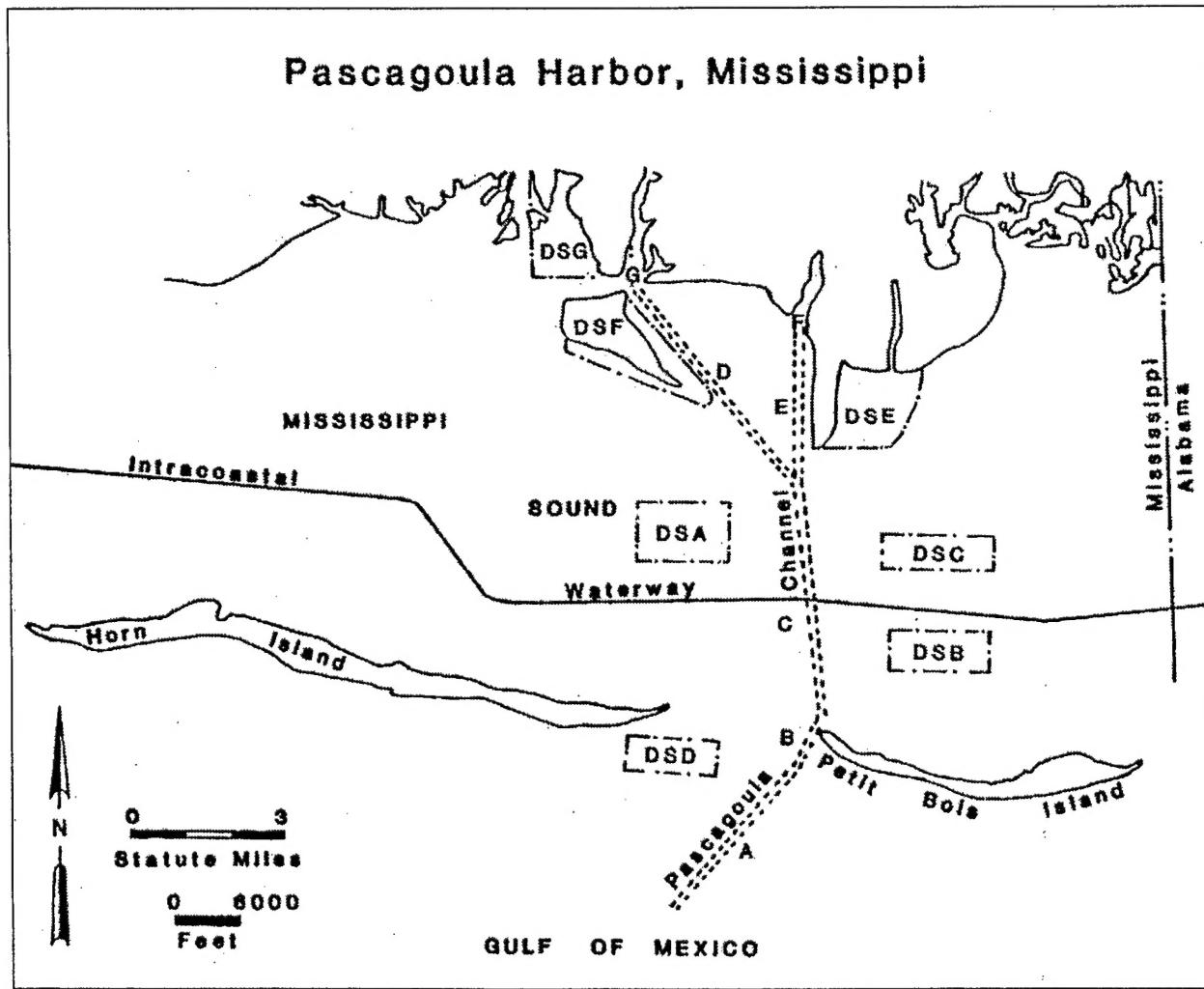


Figure 2. 1983 project area map showing areas surveyed. Note Segments D and G (as presented in Mistovich et al. 1983:100).

Mistovich et al. (1983:126) did, however, locate two possible wreck sites that are close to the current project area (Figure 3—listed as Correlation No. 3 and No. 4). Correlation No. 3 is listed as an unknown vessel and gives two possibilities. The pleasure craft *Mary Ann* sank in 1981 and was salvaged shortly after, while in 1975 the 195-foot steel barge AGS 342 was reported stranded at this location. No report was made of removal or salvage of the barge, although Mistovich et al. state that it was reasonable to assume that it was removed at some point (1983:107-128). Correlation No. 4 is listed as an unidentified pleasure craft that foundered at this location in 1982. Subsequent attempts by the U.S. Coast Guard failed to relocate the wreck (Mistovich et al. 1983:128).

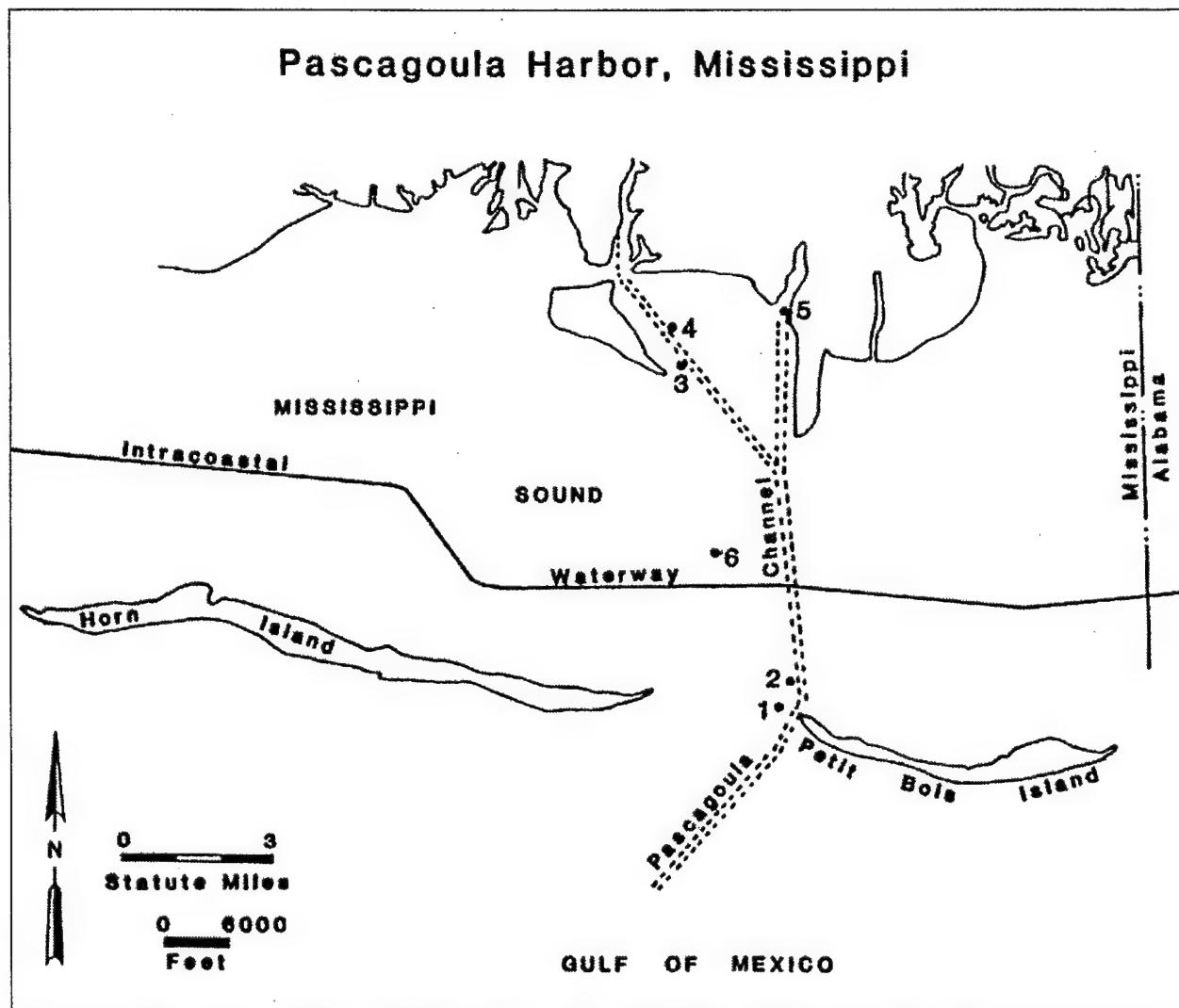


Figure 3. Map of anomalies correlated with known wreck sites. Note Correlation No. 3 and No. 4 (as presented in Mistovich et al. 1983:126).

During May of 2000 Emerald Ocean Engineering of Pensacola Beach, Florida was contracted by the U.S. Army Corps of Engineers, Mobile District to conduct a review of the past cultural environment as well as an underwater remote-sensing survey of the proposed expansion area of the existing ship channel between Singing River Island and the Ingalls Shipyard, Pascagoula Harbor, Mississippi. The review of the past cultural environment included a historical background chapter describing the Era of Exploration, the Era of Colonization, the Early American Era, the Civil War and Reconstruction Era, as well as a review of shipbuilding in

Pascagoula and the variety of vessel types which plied the waters off the Gulf Coast during the historic period. Such vessels included (but were not limited to) barques, brigantines, frigates, ketches, pinnaces and a plethora of other watercraft.

The underwater remote-sensing survey included the use of a Reson Sea Bat Model 8101 Multi-beam Sonar, an Imagenex Model 858 Side Scan Sonar, a Geometrics G-881 Marine Magnetometer, and a Trimble DSM-Pro Global Positioning System (McGehee et al. 2000:28). A review of the remote-sensing data identified 13 magnetic anomalies and/or anomaly clusters. Of these 13 magnetic targets only four were recommended for either avoidance or additional investigation. The sidescan sonar survey located six sidescan sonar targets which were recommended for additional investigation to determine their potential significance. It was these nine targets which were slated for relocation and diver investigation by Panamerican.

A number of other remote-sensing surveys and underwater archaeological research have taken place in the Gulf Coast, centered mainly around Biloxi and Mobile Bays. One of the earlier studies, titled *Cultural Resources Survey of Mobile Harbor, Alabama*, outlined the cultural and maritime history of the Mobile Bay region, a typology of vessel types (sixteenth to twentieth centuries), previous cultural resource studies in the area, and a documentary record of submerged cultural resources (Mistovich et al. 1983).

In 1983 the U.S. Army Corps of Engineers, Mobile District contracted with Espy, Huston & Associates, Inc. (EH&A) of Austin, Texas to conduct a Phase II assessment of 12 magnetic anomalies as part of a planned harbor expansion and modification of Mobile Harbor, Alabama (Irion and Bond 1984). The investigation concluded that 11 of the anomalies were modern debris and not significant for the purposes of the investigation. Target TB-4-3 was, however, deemed potentially eligible for inclusion to the NRHP; it represented a network of Confederate defense works employing the use of vessels loaded with brick as a means of coastal defense (Irion and Bond 1984:91). The report concluded with a series of suggested research topics and questions to be considered for future investigations and mitigation efforts regarding Target TB-4-3.

As a result the archaeological testing of a portion of the Confederate harbor obstructions was then undertaken by EH&A after the Corps modified the contract to conduct further testing of TB-4-3. The modification included the investigation of the brick mound to determine if hull remains existed beneath it and to identify the spatial and construction features of any extant hull remains (Irion 1985:3). The investigation located what was left of three hull remains. Preliminary assessment identified the remains of a flatboat, a stern-wheel river packet, and a side-wheel steamer (Irion 1985:54). Only additional testing of the purported *Carondolet* (the southernmost vessel) was recommended, including a minimum of three trenches across the bow, stern, and midships area in an effort to determine the vessel's hull construction features and state of preservation (Irion 1985:55).

Additional cultural resource investigations of Mobile Harbor continued in 1985 to investigate 22 magnetic anomalies and to delineate the physical extent of the Confederate obstructions at Dog River Bar (State Historic Site 1Mb28). Funded by the USACE, Mobile District the investigation was contracted to EH&A of Austin, Texas. Conducted as part of the proposed Mobile Harbor Deepening Project, the investigation identified the 22 magnetic anomalies as modern harbor debris "for which no further work is required" (Bond 1986:ii). While the investigation concluded that the three previously identified vessels (Irion 1985) would be affected by the proposed Mobile Harbor Deepening Project, additional brick-laden vessels were found south of the purported *Carondolet* site (Bond 1986:45-46). It was conjectured that as many as eight additional vessel hull remains (including the *Phoenix* and the *Thomas Sparks*) exist within the area but would not be affected by the proposed turning basin construction (Bond 1986:51).

Work in Mobile Harbor continued in 1994 when Panamerican was contracted by the Alabama Department of Transportation (ALDOT) to conduct a historical assessment of three bridge replacement locations relative to the potential for the presence of nonrenewable submerged cultural resources at these three locations. Results of the assessment indicated the potential for prehistoric human habitation sites as well as historic shipwrecks and lost/abandoned historic materials (Duff and James 1994:68). Recommendations included a diver investigation of the specific areas of potential impact including a visual/tactile survey and hydraulic probing since the ferrous metal in the existing structures would affect any magnetometer survey results. Further archival research was also recommended relative to the Civil War Union warship losses and post-war years salvage efforts on those wrecks (Duff and James 1994:69).

Again in 1994 ALDOT contracted Panamerican to conduct submerged cultural resource investigations at the proposed US-90 bridge replacement sites across the Tensaw-Spanish River, Apalachee River, and the Blakely River. The investigation included the use of a sidescan sonar to identify any exposed vessel remains at all three river crossings. Diver investigations were to be conducted only at the bridge construction site on US-90 (BRM-7501) across the Tensaw-Spanish River (Duff and James 1995:ii). Results of the sidescan sonar survey identified three potentially significant anomalies in the Blakely River survey area (which were recommended for additional testing) as well as pilings associated with Confederate obstructions near the Apalachee River survey area which were also recommended for additional investigation (Duff and James 1995:26). Although some obstructions were encountered during the underwater archaeological investigation within the Tensaw-Spanish River project area, no potentially significant submerged cultural resources were identified.

Relative to the findings above ALDOT again contracted with Panamerican in 1995 to conduct additional diver evaluations at the proposed US-90 bridge replacement construction sites (across the Apalachee and Blakely Rivers), Mobile and Baldwin Counties, Alabama (Duncan 1995:1). Diver investigations included the use of a hydraulic probe at proposed pier replacement locations as well as ground truthing of sidescan sonar targets identified in the Blakeley River (see Duff and James 1995). While obstructions were identified during the diver investigations all were either modern or natural debris and did not represent potentially significant submerged cultural resources (Duncan 1995:12).

During the removal of one of the old US-90 pilings and construction of Bent #10, ALDOT encountered cultural remains consisting of cut masonry stone and ceramic tile material. In response an underwater archaeological examination was undertaken by Panamerican to assess whether or not any significant submerged cultural resources were being impacted by the bridge construction (Krivor 1997:1). Review of the material recovered by ALDOT and diver investigations concluded that the material likely represents some form of early twentieth century fill material used in the construction of the 1926-27 Tensaw-Spanish River Bridge (Krivor 1997:18). Recommendations indicated that no further underwater archaeological investigations were necessary at this location.

Other studies along the Gulf Coast include a review of waterborne commerce and transportation within the USACE, New Orleans District, including an inventory of underwater cultural resources (Pearson et al. 1989); an underwater investigation of Ship Island Pass in Gulfport Harbor, Mississippi (Irion 1989); a cultural resource assessment for a casino and marina, Back Bay Biloxi, Mississippi (Mistovich et al. 1993); and the evaluation of the Back Bay Biloxi Shipwreck Site (State Site 22JA542), Jackson County, Mississippi (Krivor 1998).

HISTORICAL BACKGROUND

The Era of Exploration

The first officially recognized exploration of the Gulf Coast area is that of the expedition of Alonso Alvarez de Pineda in 1519. However, it is possible that the northern coast of the Gulf of Mexico was explored by unknown parties before any of the later, historically recorded expeditions. The earliest period of exploration, during the late fifteenth and early sixteenth centuries, is characterized by a scarcity of documentation. The best evidence that the area may have been explored prior to any documented expeditions can be seen in some of the earliest maps of the Americas. The maps of La Cosa (1500), Cantino (1502), Caniero (1502), and Waldseemuller (1507) each contain detailed representations of the Florida peninsula and the Gulf Coast which would indicate some familiarity with the area (Duff and James 1994:33). While this suggests early, unrecorded voyages of exploration, it has been pointed out that during this time claims were still being made that the newly discovered lands were the fringes of the Orient, which Columbus claimed to have discovered, and that those early maps may only depict the southwest coast of Asia as it was known from the overland journeys of Marco Polo, which preceded the Columbian voyages (Fite and Freeman 1926:16, 26, 34).

Regardless of whether these maps depict knowledge gained during exploration of the Gulf Coast or were merely misplaced representations of old knowledge, there is other evidence for early, unrecorded explorations of the coast. As early as 1513 an expedition of Ponce de Leon on a voyage to Florida recorded encountering a Spanish-speaking Indian. Additionally, in 1528 Narvaez recorded the presence of European objects in the possession of Indians in northern Florida, who related that the objects had originated in the Apalachee area in the Florida panhandle (Smith 1971:56-58). Also, early sixteenth century European objects have been found in several prehistoric sites on the northern Gulf Coast (Duff and James 1994:34). However, these goods could just as easily have traveled overland via aboriginal trade routes as been brought directly to the area by early explorers.

Beginning with the Pineda expedition of 1519 and including subsequent expeditions of Narvaez, de Soto, and Tristan de Luna, the Spanish explorers were charged with the exploration and settlement of the Gulf Coast. Francisco de Garay, the governor of Jamaica who outfitted the Pineda expedition at his own expense, had high hopes for the newly discovered Gulf Coast (he even named it "la Provincia de Amichel"). Indeed, the Pineda expedition reported encountering inhabitants adorned with gold jewelry, and finding gold-bearing streams (Galloway 1995:78). However, the archaeological record does not support this evidence, and subsequent explorations indicated that the region contained no treasure and no empires worth conquering. The Spanish subsequently devoted much of their attention to La Florida. The lack of documentary and cartographic information for the remainder of the sixteenth and for most of the seventeenth centuries indicate disinterest in the area by the Spanish.

The Era of Colonization

The European return to the area began with a renewed interest in the central Gulf Coast by the failed attempt of Rene-Robert Cavelier, Sieur de La Salle, to expand the area claimed by the French Crown for the territory of Louisiana. In 1685 La Salle attempted to establish a colony on Matagorda Bay in what is now eastern Texas after failing to re-locate the mouth of the Mississippi River, down which he had sailed on a previous expedition. Although La Salle lost his life in the colonization attempt and the colony failed, the French interest in a territory that the Spanish regarded as their own stimulated a renewed effort by Spain to explore and consolidate their hold on the central Gulf Coast.

The French attempt to secure control of the southern terminus of the Mississippi River system was soon renewed. In 1698 an expedition sailed under the command of Pierre Le Moyne, Sieur de Iberville, to locate the mouth of the Mississippi River. The Iberville expedition was to begin another colony to secure access through the Gulf of Mexico to the vast French territory of Louisiana. Finding that the Spanish had recently established a new foothold at Pensacola, Iberville sailed west. In April of 1699 he visited the Pascagoula River mouth and attempted to establish a fort and settlement on the western bank of the delta. However, he soon discovered the river mouth and bay to be too shallow to make a good harbor and abandoned the attempt (Higginbotham 1967:1-2). He eventually established a base at Biloxi.

Permanent European settlement of the area began as the result of the efforts of Iberville's younger brother, Jean Baptiste Le Moyne, Sieur de Bienville, to move the colony to Mobile Bay, a location which he considered better suited to maritime trade. A French seat of government was established in 1702 at Port Dauphin on Dauphin Island near the entrance to Mobile Bay. It remained there until 1720 when it was moved to Biloxi and then to New Orleans in 1722, where it remained until the close of the French period. However, the Gulf Coast remained important from a colonial and trade standpoint (Hamilton 1910:102).

In spite of all the French activity the population in the region remained small. In the early eighteenth century three royal concessions were granted to colonists in the Pascagoula area. These included La Pointe on the eastern side of the Pascagoula River delta and Graveline on the west. A third concession on the upper Pascagoula River was established by Chaumont. Although Chaumont's concession was dissolved shortly after it was established, four families remained and formed most of the European population of the Pascagoula area. In addition to the La Point, Graveline and Rilleaux families, there were the Krebs, who were descended from an early German immigrant to the La Point concession and became the predominant family in the later years of the eighteenth century, and continued to be so after the region passed to British control after the Treaty of Paris in 1763.

Following the French and Indian War the Treaty of Paris gave the French territories east of the Mississippi River to Great Britain. The Gulf Coast region came under the jurisdiction of the West Florida administrative district. The British granted further tracts of land to additional colonists and expanded maritime commerce to the area. Commerce focused on the export of products obtained in trade with the local Indian tribes—primarily animal hides and pelts. Emphasis was also placed on the production of timber, naval stores, indigo, and cotton. During the French period trade had been a government monopoly, while under British rule trade was conducted by private enterprise, with a resultant increase in capital for local investment and expenditure. However, much of this effort was centered on the Mobile Bay area and consequently, Pascagoula received little attention by the British.

After the Revolutionary War the region passed back to the Spanish. The few colonists in the Pascagoula area were allowed to keep their land holdings after giving an oath of allegiance to Spain and the Catholic church. The population remained low during the Spanish period (Higginbotham 1967:4-11).

Since the European population of the Pascagoula area remained low throughout the colonial period, there is not much information to relate regarding the economy and maritime history of the area. Initially the colonists cultivated grains and other vegetable products, including cotton and tobacco. Cotton was likely very important to the Krebs plantation, as Cain (1953:74-76) states that Krebs had invented an efficient cotton gin by 1772, more than twenty years prior to Eli Whitney's patent. Later in the colonial period and into the nineteenth century, however, emphasis changed from cultivation to the raising of livestock, as the surrounding region was apparently better suited for this type of economy (Mistovich et al. 1983:15).

Early American Era

The Gulf Coast region was annexed by the United States in 1810 as part of the Louisiana Purchase. However, the non-Spanish majority were not absorbed willingly. Prior to the purchase of the territory from the French these inhabitants rebelled, drew up a declaration of independence, and established the Republic of West Florida. It took a show of force by the United States to complete annexation of the newly formed but not officially recognized republic. Two years later, the Pascagoula region became part of the Mississippi Territory. Mississippi achieved statehood in 1817.

Early in the American Era, prior to 1840, the economy remained similar to that of the Colonial Era, with the predominant livelihood coming from cattle herding and supplemented by small-scale farming and hunting. However, at the same time in the interior of the state the production of cotton was rapidly transforming the economy of the south. The larger port cities of New Orleans and Mobile prospered from the outflow of this new product. Since Pascagoula lacked a major navigable waterway extending into the interior, and hence into the cotton belt (the head of navigation for shallow draft vessels was the confluence of the Leaf and Chicasaway Rivers in Greene County), its participation in this booming trade was limited, and commercial steamboat traffic never really prospered (Cain 1962:41).

In spite of these shortcomings numerous attempts were made to extend the head of navigation, and trade was eventually established to the town of Enterprise. In 1818 the Mississippi Legislature appointed a commission to improve the navigability of the Pascagoula River system. Through a state lottery and land sales (Cain 1962:42), enough revenue was generated to operate a snag boat, and by 1842 the Chicasawhay and Pascagoula Rivers had been cleared of numerous obstructions. Although the completion of the Mobile and Ohio Railroad in 1855 quickly ended what little steamboat trade had been established, for a time a successful cotton trade between Pascagoula and Enterprise existed. With the establishment of the railroad the rivers ceased to be a viable route for the transportation of goods, and were virtually forgotten until the timber trade of the later part of the nineteenth century.

Civil War and Reconstruction Era

Pascagoula was not a hotbed of military activity during the Civil War. As far as the historical record of shipwrecks is concerned, the Pascagoula area was virtually shut out of the war. Two exceptions exist to this statement. A common strategy employed by both sides during the war to obstruct navigation involved the scuttling of old or derelict vessels in navigation channels. Admiral Farragut's West Coast Blockading Squadron employed this as part of his effective strategy in the blockage of Mississippi Sound. Between 1862 and 1863 Union forces sunk six small captured fishing vessels in Petit Bois Pass to block the passage to Confederate blockade runners. Also, in a separate incident, the blockade runner *Fanny* was chased through Horn Island Pass and into Pascagoula Bay, where it was run aground on the Pascagoula beachfront. The wreck supposedly is still there (Cain 1962:68; Higginbotham 1967:37-38).

Like the rest of the South after the Civil War, Pascagoula suffered Reconstruction era woes from 1865–1877. The one bright spot was the south Mississippi lumber industry, which began with the export of spare timber in the 1830s and 1840s. By the 1870s Pascagoula was experiencing the great “Lumber Boom” as it was called (Mistovich et al. 1983:18). Lasting until the 1930s, this boom transformed Pascagoula into a major international lumber and timber products exporting center by the 1880s. The replacement of axes with crosscut saws in the late 1880s tripled the output of logs, and by the time the boom ended, hundreds of thousands of logs had traveled down the Chicasawhay, Leaf, and Pascagoula Rivers to sawmills in the Moss Point and Pascagoula vicinity. By the turn of the century many commercial sawmills and log booms were

in operation in the Pascagoula area, the most prominent of which were operated by the Robinson, White, Denny, Dantzler, Gautier, Tam, Danner, McIntosh, and Farnsworth companies (Mistovich et al. 18983:18). During this time the lumber industry thoroughly dominated the local economy in much the same way the steel industry dominated the Pittsburgh economy during the early to mid-twentieth century. The industry reached its peak during the first decade of the twentieth century and declined from then on as the timber stands of the pine barrens were logged out. As with the short-lived cotton trade of the nineteenth century, the completion of a railroad, this time extending from the interior to Mobile, served to signal the demise of the lumber industry, and it was largely defunct by 1930 (Cain 1962:43-45).

Although the timber industry was the dominating factor in the boom of the late nineteenth and early twentieth centuries, other industries also played a part. Wood product industries, including the production of turpentine and charcoal, added to the prosperity of Pascagoula and Moss Point. Large quantities of these products were shipped to largely domestic markets via small coastal sailing vessels called "charcoal schooners" through Pascagoula. In addition to the wood products, paper production contributed to the local economy, eventually becoming the second most important local industry as the timber industry began to decline.

In accordance with this booming local economy and fueled by the hope that Pascagoula would surpass Mobile and New Orleans as the most important trade center on the Gulf Coast, various projects were undertaken to improve navigation in the river system and improve access to the Horn Island Harbor and Pascagoula Harbor. In 1869 the state of Mississippi issued a private charter to complete what would become known as Noyes Channel, an 8 ft. by 60 ft. channel across the Pascagoula River bar. It was completed in 1870, and the private authority which oversaw the operation charged a toll for outgoing vessels. The U.S. Army Corps of Engineers, after preliminary surveys in 1873 and 1878, recommended that the state of Mississippi revoke the private charter and allow federal involvement. Accordingly, in 1880 the USACOE undertook the improvement of Horn Island Harbor, Pascagoula Harbor, and the lower Pascagoula River. Various fiscal appropriations were made in succeeding years, and by 1907 all but the largest seagoing vessels could ascend directly to Moss Point. This dredging and improvement directly stimulated seagoing trade to Pascagoula by eliminating the need for lighterage over the bars at Horn Island Pass and the mouth of the Pascagoula River.

Shipbuilding in Pascagoula

Another important industry in the Pascagoula area, and one which is strongly related to submerged cultural resources, is the shipbuilding industry. Beginning from the earliest commercial shipyard established by Ebeneezer Clark in 1843 just north of Moss Point, continuing through the years in yards established by European-descended boat builders with names like de Angelo, Flechas, Piaggio, and Toche, and including the oldest continuously operated commercial boatyard in Pascagoula, run by the Krebs family since 1883 or 1885, there has been a strong shipbuilding tradition in Pascagoula. Indeed, the Ingalls Shipyard, at the mouth of the Pascagoula River, continued to prosper into the last half of the twentieth century.

The development of the shipbuilding industry in Pascagoula mirrors the development of the shipping industry. Initial shipyards, including the Clark shipyard, concentrated on the repair of small schooners and rivercraft, with the occasional construction of a new schooner or steamer. The number of boatyards gradually and steadily increased through the late nineteenth century and into the early twentieth. The opening of Pascagoula Harbor to seagoing vessels in 1906 allowed larger shipyards to be built and to prosper. Even larger shipyards were opened during World War I to construct liberty ships under the United States Emergency Fleet Corporation. It was during this time that Moss Point became an important industrial center. The same occurred during World War II, when the Ingalls Iron Works, which had purchased the Gulf Ship Company

(which had become the F.B. Walker and Sons boatyard in 1937), produced vessels for the Allied cause at their shipyard by the Pascagoula River. Between the wars a temporary lapse in shipbuilding occurred, ameliorated somewhat by the production of fishing craft.

Vessel Types

A multitude of European-built or European-style vessels were in use during the period of exploration and discovery. However, there is little specific information on vessels in use prior to 1870. Most records only give brief descriptions of the vessel type and little else. Therefore, it is often hard to distinguish among various types of vessels of the period by description alone. Many vessels were described by hull type, whereas others were described by their rig or sail configuration. Still others are described by both hull and rigging type. In any case differences in vessel type are not always clear, and it is not always certain that any given vessel was described correctly at the time.

The first vessels to explore the Gulf Coast were small, ranging from 35 to 60 tons' burden. Most vessels remained small until after 1736, when they frequently ranged upwards of 500 tons. While many vessels before 1736 were 50 to 60 tons in range, many were between 100 and 200 tons burden. Even in 1759 small vessels of 50 tons were known to have made the passage from France to the Gulf region (Surrey 1916:78).

The bark (or barque) has been described as a three-masted vessel with the fore and mainmast square rigged, while the mizzenmast was fore-and-aft rigged (Kemp 1993:61–62) (Figure 4). Barks recorded by Chapman during the eighteenth century ranged in length from 64 feet (17 feet in beam) to 112 feet (27 feet in beam) (1768:37–40).

Another type of vessel in use in the area during the age of exploration was a brigantine. A brigantine was two-masted, square-rigged on the foremast, and fore-and-aft rigged on the mainmast (Kemp 1993:109) (Figure 5). In 1718 an inventory of vessels in the Gulf was taken; several were listed as "brigantins." One in Mobile was rated between 25–40 tons' burden; another at Biloxi rated from 30–35 tons' burden (as did a vessel named *Le Pinere* located between New and Old Biloxi). Two of the vessels were stranded and badly worm-eaten but could be repaired and put into service, "except the one at Biloxi" (Surrey 1916:71). Three other brigantines were at New Orleans, each ranging from 15–50 tons respectively (the 50-ton vessel being in a bad state of decay). Previous to 1731 the Company of the Indies began construction of a "brigantin" roughly 45 feet in length with a 19-foot beam. The vessel had a draught of nine feet and a 76-ton capacity (Surrey 1916:71).

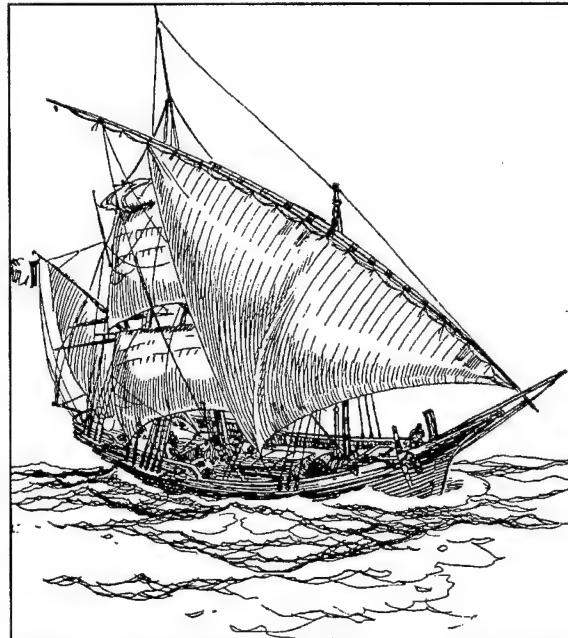


Figure 4. The barque *Provencale* (as presented in Culver 1992:136).

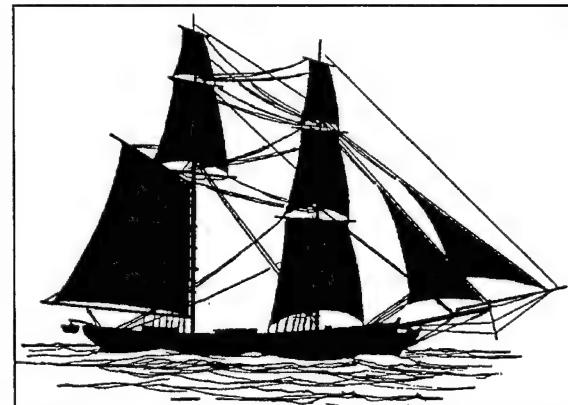


Figure 5. Typical rigged brigantine (as presented in Bloomster 1940:9).

During the eighteenth century the English used vessels called corvettes to explore the Gulf Coast as well as the Mississippi. Although originally a French design, no reference has been found noting that the French were using this type of vessel in the Gulf region during the eighteenth century. A corvette is defined as a flush-decked warship with a single tier of guns, and smaller than a frigate (but ship-rigged on three masts; Kemp 1993:207) (Figure 6). In the eighteenth century a corvette was defined as a two-masted vessel with a bowsprit carrying a spritsail. After time the corvette design was modified, its size approaching that of a ship (Culver 1992:188).

Feluccas have also been mentioned as a vessel type in numerous French accounts from the eighteenth century. Described as small, fast sailing ships that could be powered by sail or oars, the use of feluccas in the Gulf region has been well documented. These vessels were used as coasting as well as transport vessels. Descriptions state that the vessel was a double-ender and could be sailed or rowed from either end (Surrey 1916:63). Records of a Spanish felucca built in Havana in 1786 state the vessel was 100 feet long and 27 feet wide (Mistovich and Knight 1983:31). However, draught lines of a French felucca recorded in the eighteenth century show a vessel with a length between perpendiculars of $43\frac{7}{8}$ feet and a moulded breadth of $8\frac{3}{4}$ feet. The vessel had a draught of $2\frac{1}{12}$ feet (Chapman 1768:70). The example from Chapman shows a vessel with a distinct bow and stern and would have therefore not been a double-ender.

The French used the term “flute” to describe a vessel that had had some of its guns removed or moved below in order to make additional room for stores or troops (Figure 7). The word is the anglicized version of the Dutch term *fluyt*, a small supply vessel with a rounded stern (Kemp 1993:318). The French expression *en flute* referred to a vessel with guns on the upper deck only, with the lower decks used for storage of goods or troops (Culver 1992:104). On his second voyage Iberville returned to Biloxi Bay on January 8, 1700 onboard the *Renommée* accompanied by the 700-ton flute *Gironde*, commanded by the Chevalier de Surgeres. Flutes were ship rigged and were therefore lengthy and wide in beam. This type of vessel would have had difficulty in passing into shallow harbors and would likely have been anchored offshore.

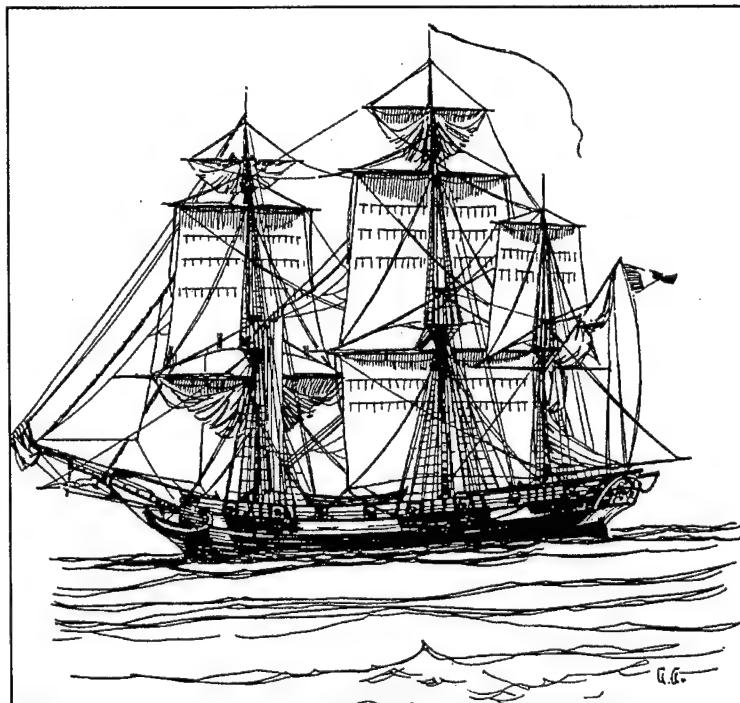


Figure 6. The corvette (as presented in Culver 1992:186).

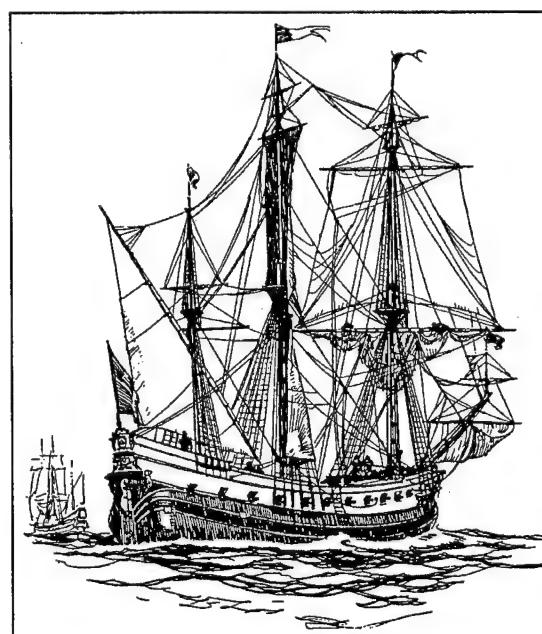


Figure 7. The flute (as presented in Culver 1992:103).

Frigates were another type of vessel used around the Gulf during the expansion of the southern territories. Iberville employed the use of two frigates (*La Badine* and *Le Marinas*) during his initial explorations of the Gulf Coast in 1699 (Giraud 1953:23). A frigate has been typically described as a three-masted, fully-rigged ship with a main deck as well as a raised quarter deck and forecastle (Figure 8). They were armed with 24 to 38 guns that were carried on a single gun deck (Kemp 1993:329). Frigates were quick sailing vessels and were often used as lookouts and messengers. Plans of frigates from the eighteenth century show that they ranged in length from 56 to over 160 feet (Chapman 1768:11–17).

The 56-foot frigate had a beam measurement of 18 $\frac{1}{2}$ feet and only one mast (Chapman 1768:17).

Another vessel in use during the era of exploration, a ketch, has been described as a small sailing vessel with two masts; the mizzen mast is stepped before the rudder head. This description is not always appropriate, as some yawl-rigged vessels also had the same mast placement (Kemp 1993:447). With the main mast stepped back along with the mizzen mast, a ketch has been generically described as a vessel without a foremast (Culver 1992:113) (Figure 9). When Iberville left France to explore the Gulf, he supposedly sailed with his two frigates (*La Badine* and *Le Marinas*) and two ketches (Caruso 1966:228). Another source states that the two vessels that accompanied Iberville were two traversiers (*Le Precieux* and *Le Biscayenne*) (Higginbotham 1968:15). Whether or not the vessels were rigged as ketches and both statements are correct is unknown. Ketches were used extensively in the coastal trade and were adopted by many of the European maritime powers during the Napoleonic wars to aid in tending fleets (King et al. 1955:221). Two ketches recorded by Chapman during the eighteenth century were 76 to 85 feet in length with beams of 21 to 23 feet respectively (Chapman 1768:49). Although ketches were known as an effective vessel type during war time, they were also used to carry freight and passengers. The main differentiating features of these vessels were the sail arrangement and the employment of cannons onboard (Surrey 1916:72).

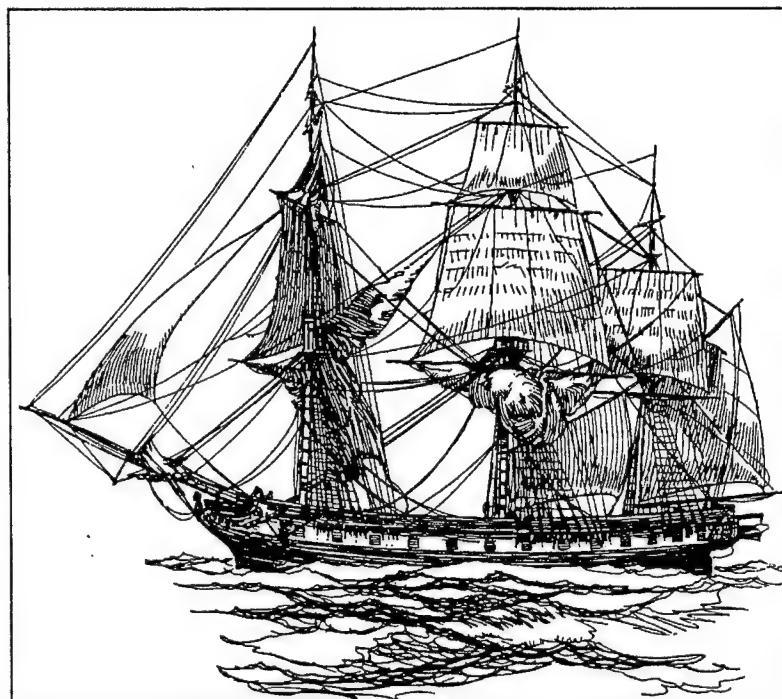


Figure 8. An 1820 frigate (as presented in Culver 1992:169).

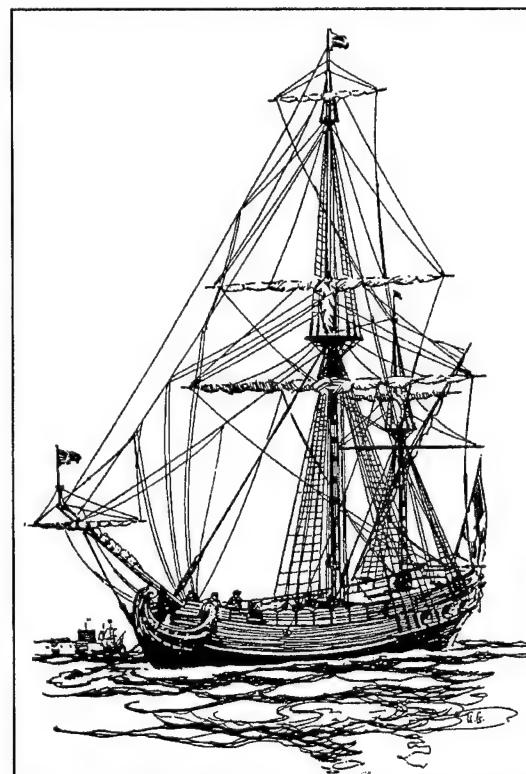


Figure 9. The ketch (as presented in Culver 1992:112).

A “longboat” is a general term for a ship’s boat, commonly a shallop. The vessel could be propelled by sail or oars and was typically round bottomed, 20 to 30 feet in length (Wilson 1983:32). Many had bluff bows with relatively narrow sterns, increasing their ability to perform as sea-going vessels (Lavery 1987:218). These boats were the largest vessels carried onboard a ship. Their principal purpose was transporting heavy stores to and from shore as well as taking water casks to shore to be filled. These boats were often stocked with provisions, as their secondary purpose was to serve as a lifeboat in case of emergency (Kemp 1993:496). Chapman surveyed a number of longboats in the eighteenth century. They ranged in length (between perpendiculars) from 18^{1/2} feet to 34 feet (Figure 10). The breadth moulded of these boats ranged from 7^{1/3} feet to 10 feet (Chapman 1768:58).

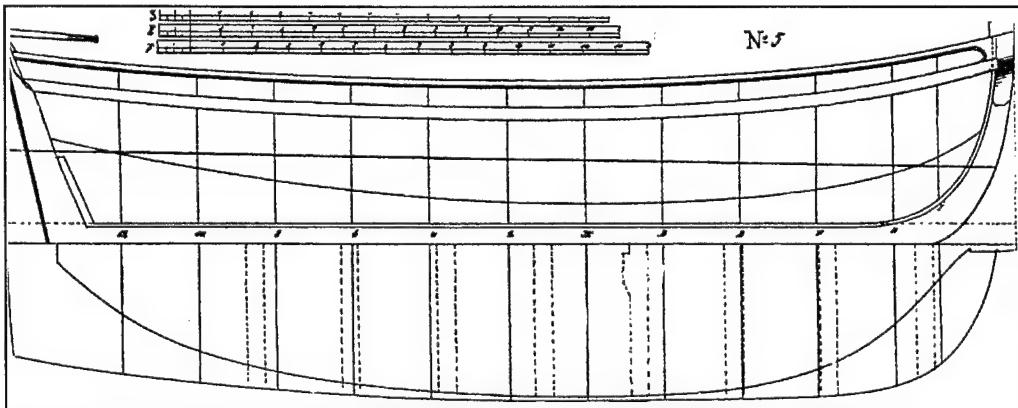


Figure 10. Hull lines of a 34-foot longboat (as presented in Chapman 1768:58).

Another vessel in use during the Age of Exploration was a pinnace, a small vessel that could be rowed or sailed and was initially designed to accompany larger ships. Although used primarily as ship tenders, pinnaces were known to accompany ships during voyages of exploration, being built to withstand substantial seas and adverse conditions. Pinnaces have been described as small ships, and the only difference between the two was in bulk and burden (Baker 1962:54). Many descriptions of pinnaces state that they had square sterns, and that the name “pinnace” came to denote a use or service rather than a specific vessel type (Baker 1962:56). Pinnaces were larger than longboats and differed from shallops in their square stern. They were rigged in a variety of ways depending on the service they were to perform; an ocean crossing would require a different rig than that of a coastal mission (Baker 1962:59). Pinnaces ranged in size from roughly 30 feet in length (Chapman 1768:51) to upwards of 90 feet (Baker 1962:76) (Figure 11).

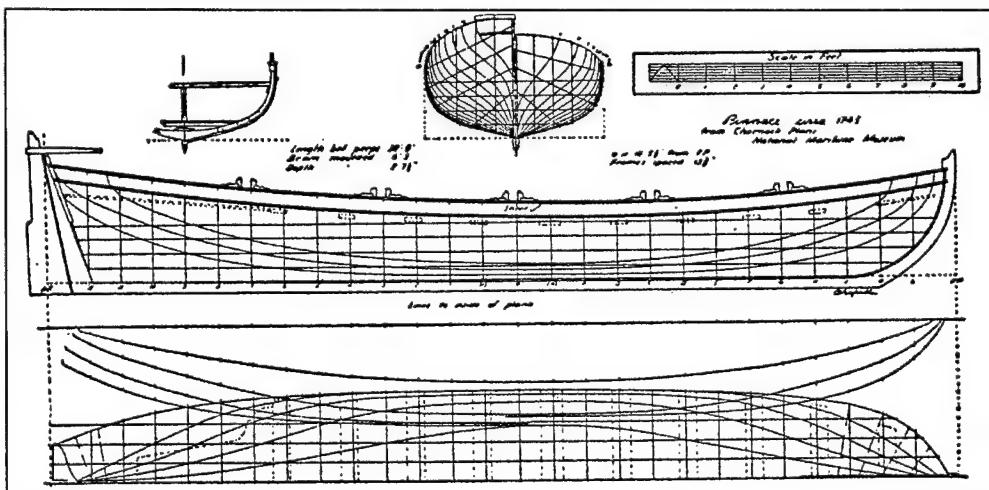


Figure 11. Hull lines of a 1700–1750 pinnace (as presented in Chapelle 1951:23).

The French used vessels called shallows (chaloupes) for a variety of reasons during the colonial period (Figure 12). Shallows were often employed by larger vessels for placing/lifting anchors and helping in times of distress (Surrey 1916:62). Shallows often varied in size from four to upwards of 60 tons. They were usually open, heavily constructed, and useful for coastwise voyages. Rigging for shallows usually included a single mast fore and aft that was rigged with a sprit mainsail and a staysail. Some had two masts with square rigging, a large mast amidships, and a small foresail stepped forward (Baker 1962:151). The term "shallop" was replaced later in the eighteenth century by the terms "longboat" and "launch" (Chappelle 1951:20). All these vessels were considered ship's boats and were used extensively throughout the eighteenth century. Surrey states that as "early as 1704 two of these boats were at Biloxi, and in 1707 were brought into the transport service"

(Surrey 1916:61). A shallop of 60 tons was also in use in the Gulf of Mexico near Deer Island (adjacent to Biloxi Bay), manned by a crew of five or six sailors (Surrey 1916:61).

Iberville made frequent mention of vessels called "smacks" during his early explorations off the Gulf Coast. However, a description of the vessel as a type is difficult to discern. A smack has been described as a small sailing vessel rigged as a cutter or ketch normally 15 to 30 tons in size and commonly used for inshore fishing (Kemp 1993:810). Smacks were often compared to "hoys" which were small coasting vessels that were constructed to upwards of 60 tons and were used extensively to transport passengers from port to port. These vessels usually had a single mast with a fore-and-aft sail (Kemp 1993:404). Chapman, in his work *Architectura Navalis Mercatoria*, provides the dimensions of a number of English and Dutch smacks and hoys. These vessels range in length from $39\frac{1}{4}$ feet (13 $\frac{1}{4}$ feet in beam) to $110\frac{1}{4}$ feet (27 feet in beam) (Chapman 1768:64–70).

Another vessel, called a traversier, has been mentioned in numerous accounts of voyages around the Gulf Coast. A traversier was often not a particular type of vessel but rather one that made frequent voyages between two points that were not far apart. In 1704 two traversiers were recorded making voyages between Louisiana and Mexico; each was rated at 50 tons. Traversiers could make passage to the West Indies and were also used as transport vessels (batiments de transport). However, Surrey states that traversiers could not get too close to shore for fear of grounding, so shallows were used to transfer supplies to shore. Traversiers were common throughout the French period in the Gulf but were employed less during the royal rule (Surrey 1916:63).

With the advent of the Colonial Era, the maritime character of the area witnessed an increasing influx of watercraft types and numbers. Vessel types present during the Colonial Era were all powered by sail and/or current, and included small coastal merchant vessels rigged as sloops and schooners, large merchantmen and warships, small local fishing craft, and early river craft which brought commodities by river to Pascagoula. During the nineteenth and early twentieth centuries, other vessel types emerged in use in the area, including river and coastal steamers, sailing craft such as lugers, sloops, schooners, ships, and barks, un-powered rivercraft of the flatboat family, Civil War vessels such as monitors and rams, small vernacular craft and fishing vessels such as bateaux, oyster boats, and bay shrimpers, as well as harbor craft like steam tugs, barges, and dry-docks.

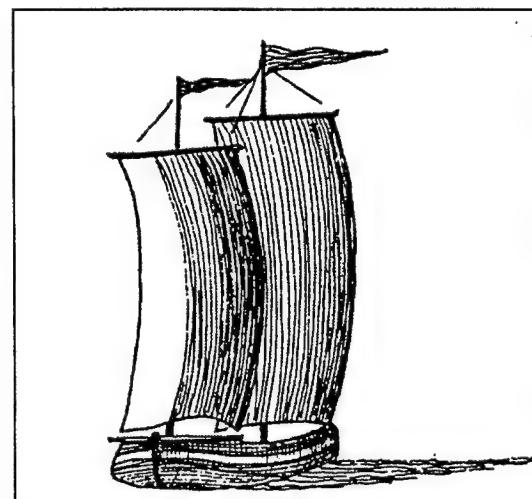


Figure 12. 1725 shallop (as presented in Baker 1962:66).

Before the introduction of steam, the bulk of farm products from the interior were shipped downriver on rivercraft of the flatboat family. Often referred to as flats, family boats, New Orleans or Orleans boats, arks, Kentucky boats, and tobacco boats, flatboats were used to transport settlers, household goods, and livestock downriver to market (Figure 13). In addition, they were also used to transport various types of cargo, including cotton, flour, bacon, whiskey, cider, pottery, and the like. When the cargo was sold the flatboats were either sold for lumber or abandoned, and their owners would return home (Baldwin 1941).

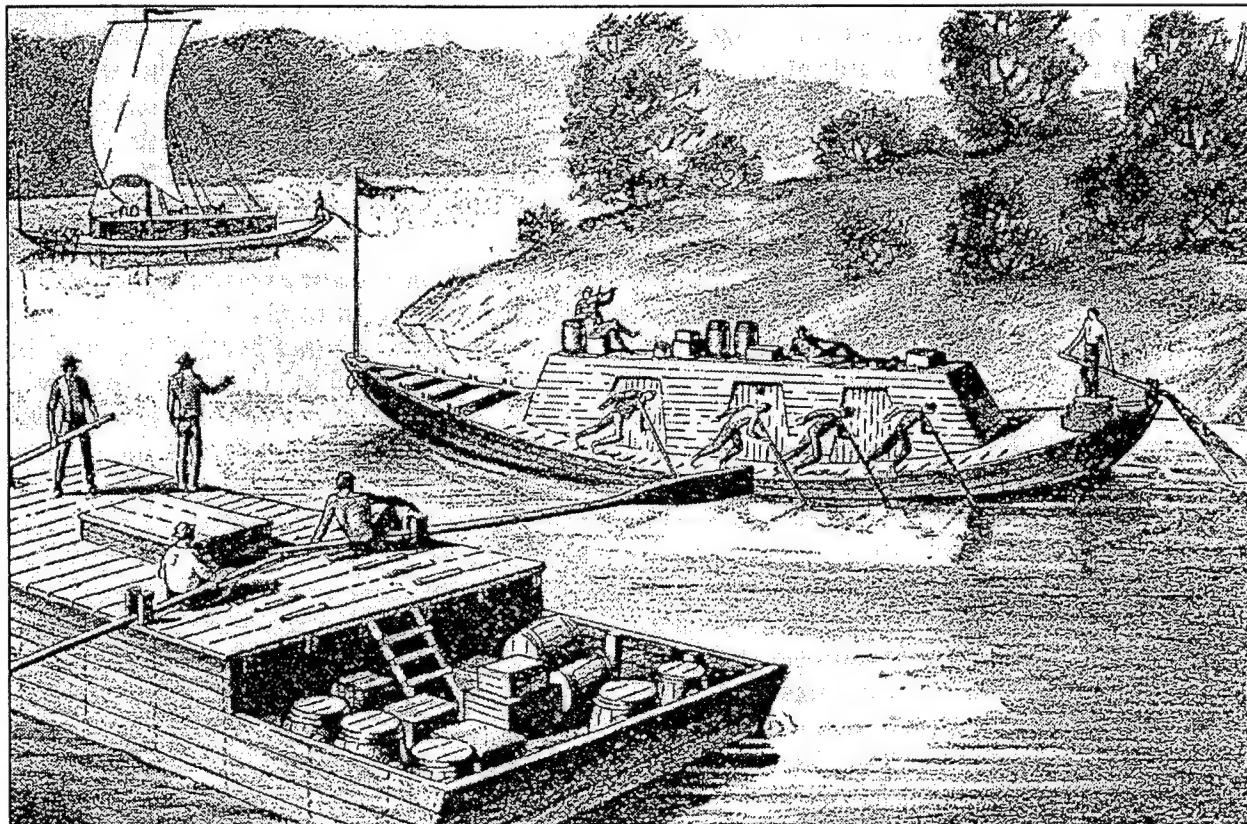


Figure 13. River scene showing a flatboat and two keelboats (as presented in Baldwin 1941:43).

Prior to the ante-bellum period the average size of flatboats increased substantially. From 1810 to 1819, the average flatboat capacity was 30 tons and cost \$45 to construct. During the period between 1850 and 1860, flatboats averaged 146 tons capacity and cost an average of \$219 to build with some able to carry 300 tons (Haites et al. 1975:15, 166). Unpowered and only able to drift downriver with the current, the size and shape of flatboats varied, but generally consisted of a flat bottom, oblong shape, and a roof supported by planked sides. The average dimensions ranged from 12 to 20 feet in width and from 20 to 150 in length. Steered by a single thirty to forty-foot stern oar and two or more side sweeps, flatboats were also equipped with fireplaces or iron stoves for cooking and heating. They seldom had windows and almost never used anchors but used a line or cable to dock the boat. Pumps were also on board in case leaks occurred (Baldwin 1941:48; Johnson 1963:116-120, 127-128).

Because the flatboat traveled only downstream a different vessel type, the keelboat and its larger relative the barge, evolved to handle upstream traffic. Coming into general use on the Ohio River soon after the American Revolution, these vessels were built on a keel (actually built-in keels), ribbed, and covered with planks (Baldwin 1941:42-44; Haites et al. 1975).

The barge was constructed similarly to the keelboat but was larger, longer, and heavier. Barges often approached 170 feet in length, drew three feet, had a mast (often two, with square sails), were steered by a rudder, and had a small cabin built on the rear deck and a footway around the gunwales. The barges were manned by 15 to 50 men, depending on the size, and carrying capacity ranged from 50 to 150 tons (Baldwin 1941; Haites et al. 1975). A variety of methods were employed to propel the barges and keelboats upstream. These included poling (if the river bottom was hard), pulling the boat along the bank with towlines, warping or cordelling using a skiff to carry towlines out to a tree on the bank and pulling the boat ahead by walking the cleated footway, and as a last resort, rowing (Baldwin 1941).

Although steamboats were introduced shortly after the advent of flatboats, keelboats, and barges, these latter types continued to be used and even increased in numbers and importance throughout the nineteenth century. However, due to the high cost of slow, upstream cargo carriage, the keelboat, although its use lingered on for decades, was the first of the early craft to feel the competition from steam. The barge, the largest of the keelboats, went out of use rapidly. The flatboat, which was economical and easy to operate, continued in use through the middle of the nineteenth century (longer than keelboats on the major trunk routes) and persisted in use into the twentieth century on streams of the rugged hill country of Tennessee, West Virginia, and Kentucky (Haites et al. 1975:119-23; Hall 1984:181-186; Hunter 1949:52-58).

The historic steamboat was one of the most prominent vessel types employed throughout the region. There were essentially two types of steamboats employed in the area: the western rivers sidewheel and sternwheeler, and the eastern seaboard sidewheeler (Figure 14). These eastern seaboard designs had long, narrow, heavily framed, flat-bottomed hulls, and were not adapted to the western rivers' low water depth. Engines, furnaces and boilers were placed within the hull of these vessels along with the cargo. The most common engine type employed on eastern steamers was a centrally-located, low-pressure, walking beam engine (Figure 15).

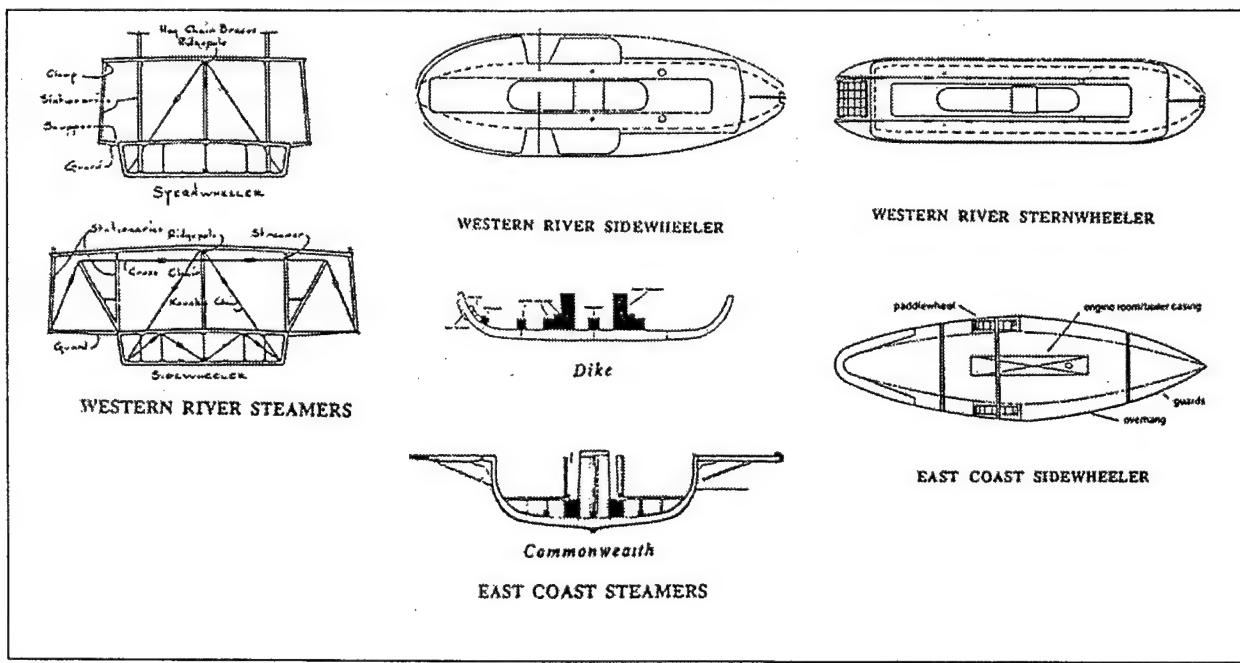


Figure 14. Comparison of hull shapes and hull cross sections of eastern seaboard and western river steamboats (as presented in Pearson et al. 1993).

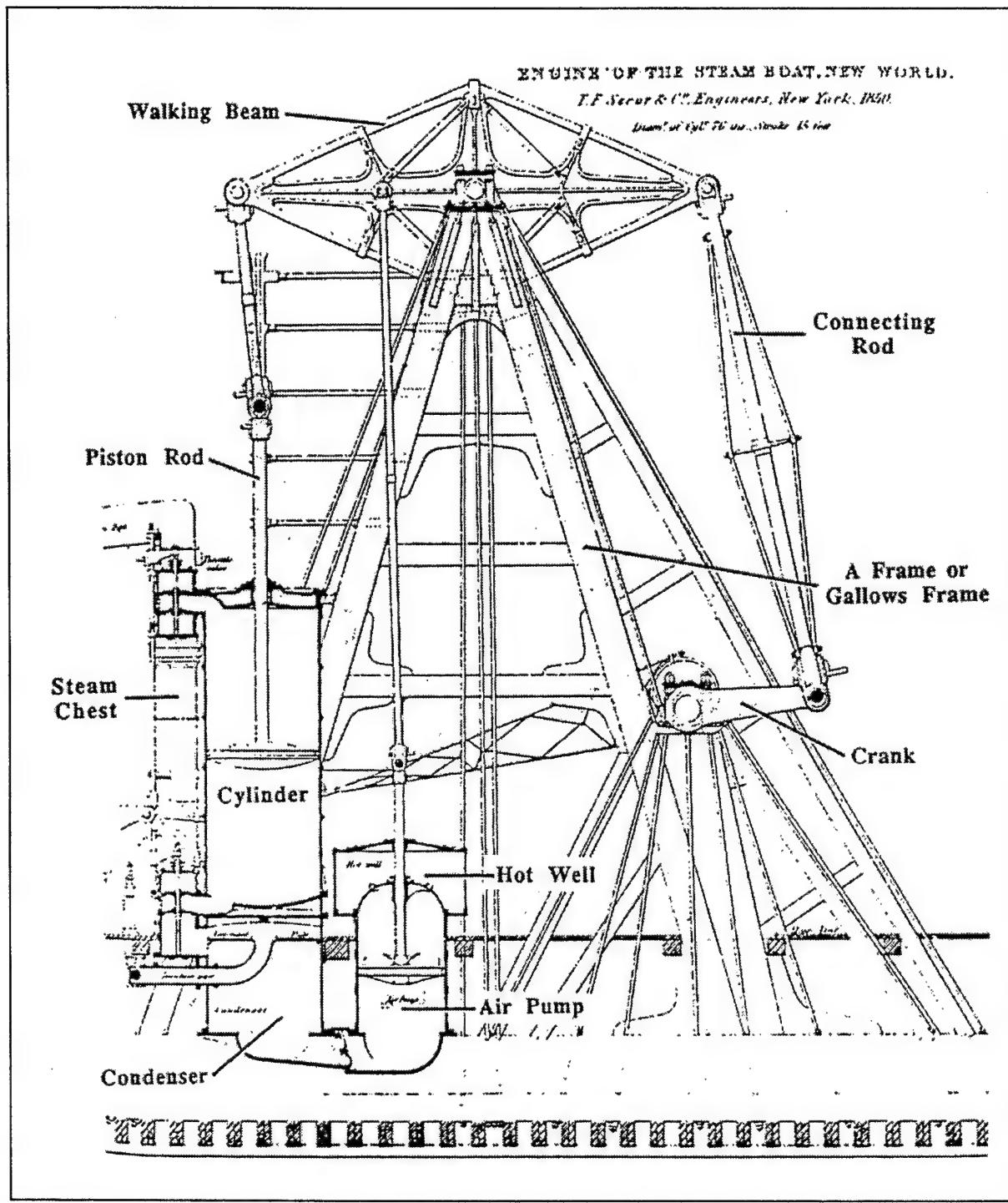


Figure 15. Major components of a mid-nineteenth century eastern seaboard low-pressure walking beam engine (as presented in Pearson et al. 1994).

The eastern-built coastal sidewheelers were well represented in the Gulf Coast area, serving as passenger and freight carriers, bay ferries and pleasure cruise boats. Steamers like the *Louis D'Olive*, built in Wilmington, Delaware, plied the waters of Mobile Bay (Figure 16). Steamers like the *Mary*, a 234-foot iron hulled sidewheeler also built at Wilmington, along with the *Alabama*, the *Francis*, and the *Louise*, were part of the Charles Morgan fleet of coastal vessels which operated in the Mobile-New Orleans trade (Pearson et al. 1994).

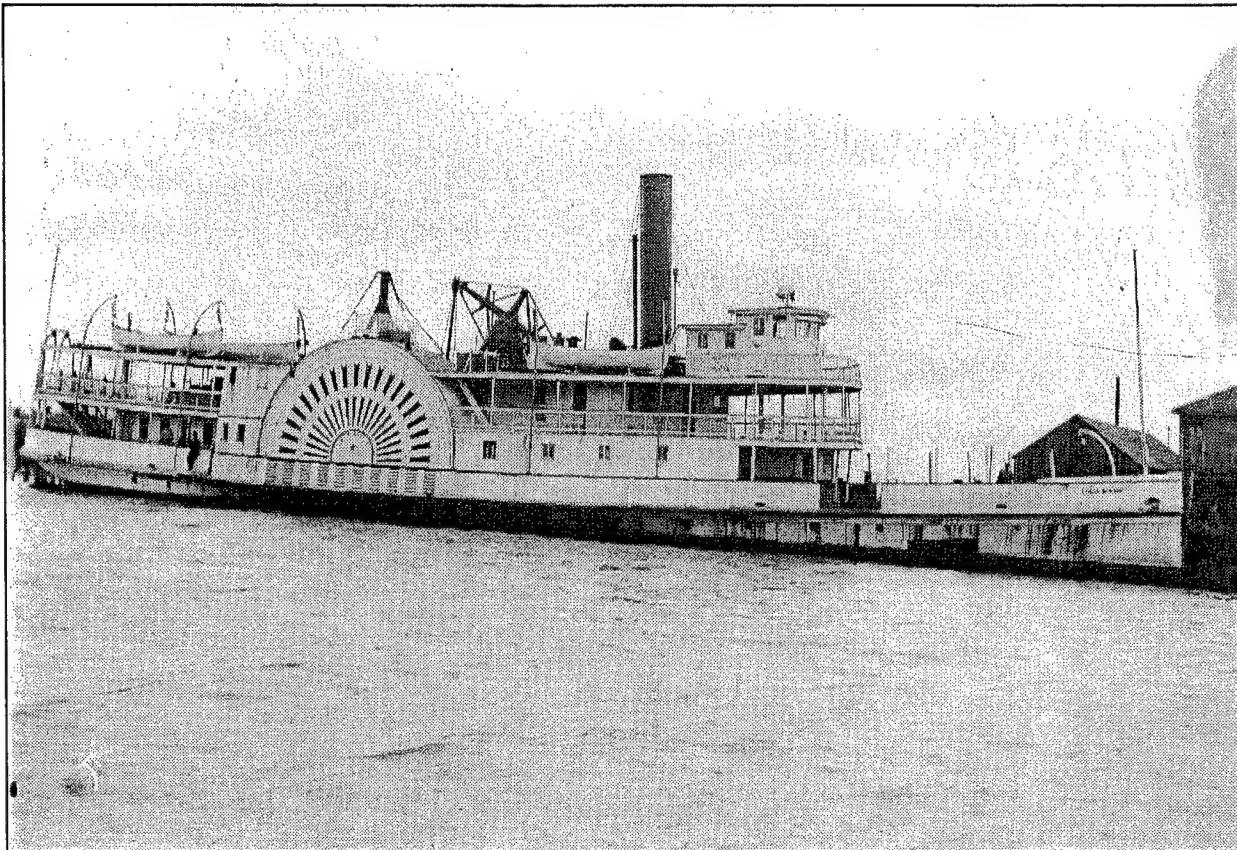


Figure 16. Steamboat *Louis D'Olive*, an eastern seaboard sidewheeler, built in Wilmington, Delaware in 1861 (courtesy of Overbey Collection, University of South Alabama Archives).

While the first western rivers steamboats did not structurally differ much from their eastern seagoing counterparts, by 1840 a vast technical change had occurred, adapting the steamboats to the natural and economic conditions of travel along the western rivers. In adapting to the natural constraints of these shallow, swift rivers, steamboats increased in length and breadth of hull and decreased in depth. In the late 1820s experimentation began with lighter methods of hull construction, and by the 1840s hull lines had become rectangular throughout with a flat bottom and straight sides, and with curved surfaces of the hull largely confined within the short distances of the bow and stern (Hunter 1949:77, 80).

Similar to the changes in vessel hulls, the propulsion systems were changing from low pressure condensing engines to high-pressure noncondensing ones. Low pressure engines, although safer and more fuel efficient, were replaced with high pressure engines that were faster and more maneuverable under the diverse navigational conditions present in western rivers. These engines were powered by long, horizontal, internal flue boilers (Figure 17). However, the major hazard associated with the high pressure engines was the common occurrence of a boiler explosion. These explosions were the greatest cause of death from steamboat accidents on the Mississippi (Duay 1992: 33-34; Donovan 1966; Hunter 1949:121-180).

Illustrated in Figures 18 and 19, the typical western river steamboat of the 1850s was a flat-bottomed, shallow-drafted side-wheeler. Four-fifths out of water, the fully developed side-wheeler had three decks: the main deck, which covered and extended beyond the hull over the water as "guards"; the boiler deck, located above the boilers; and the hurricane deck. The pilot house stood atop the hurricane deck just aft of the stacks (Hunter 1949:90-91).

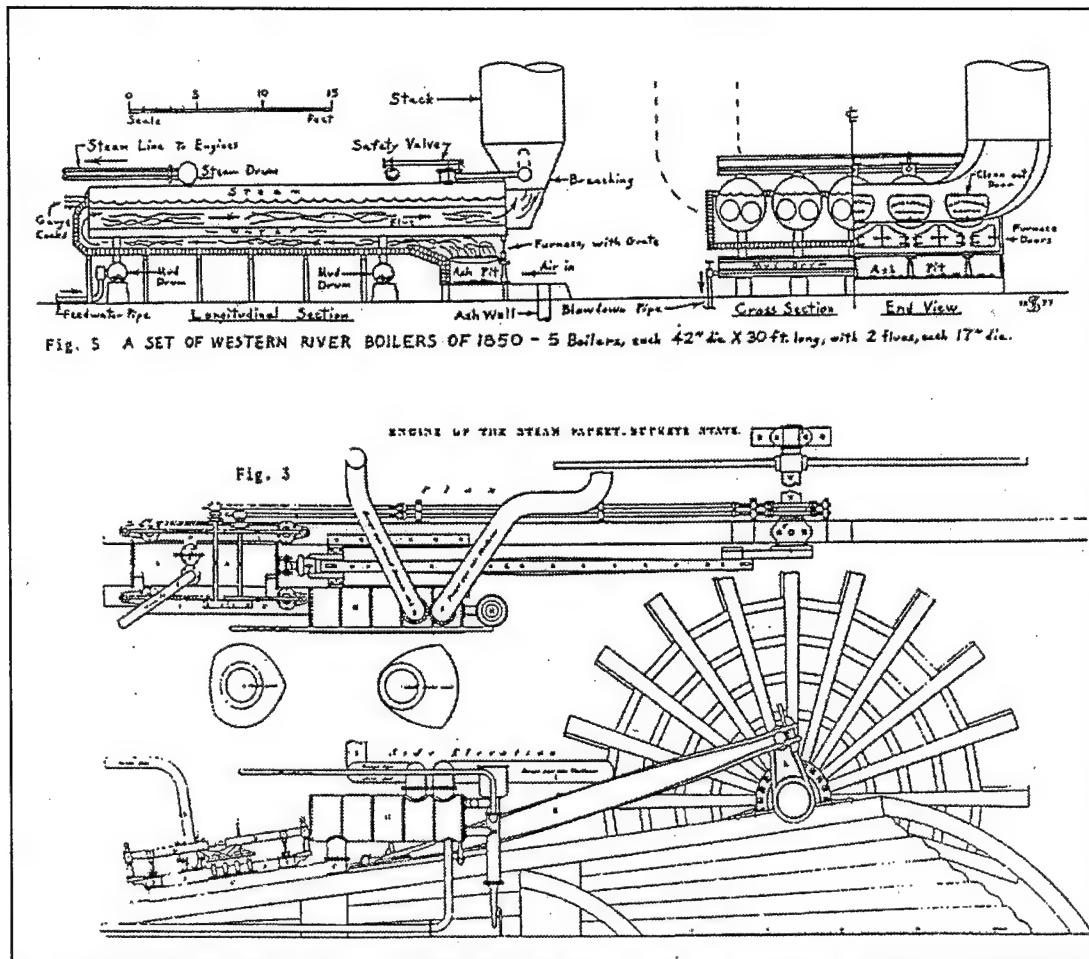


Figure 17. Illustration of an 1850s steamboat boiler and engine (as presented in Sawyer 1978:75).

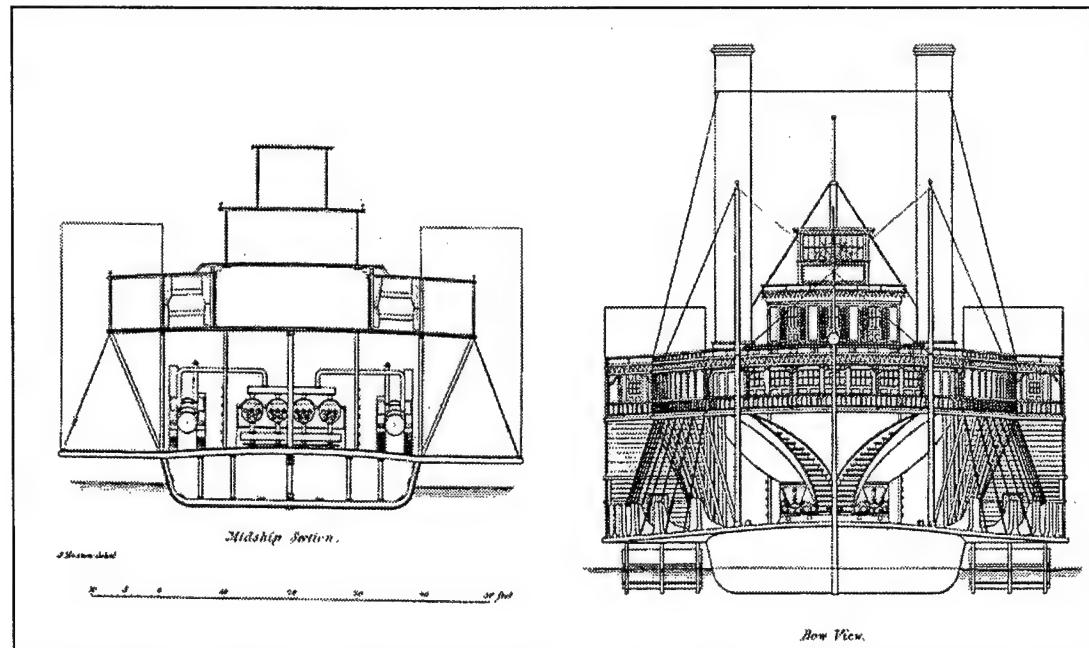


Figure 18. Midship section and bow view of a typical western rivers steamboat of the 1850s (as presented in Hunter 1949:18).

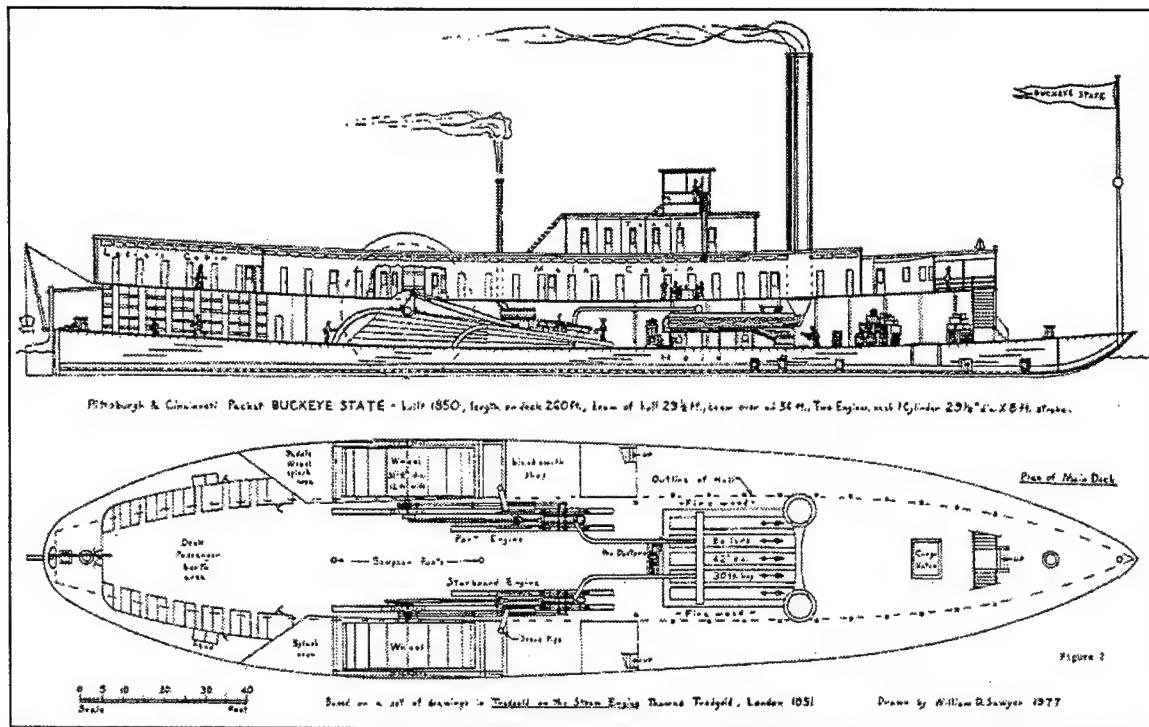


Figure 19. Plan and profile of a typical western rivers sidewheel steamboat of the 1850s (as presented in Sawyer 1978:74).

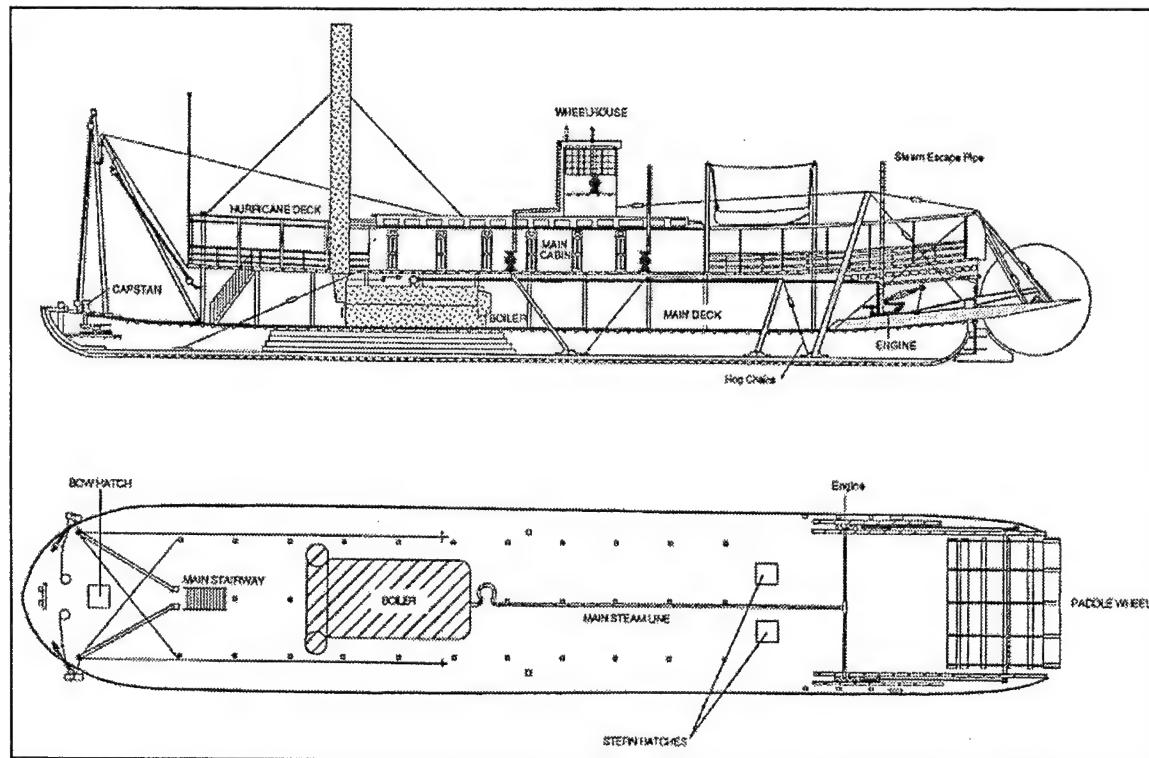


Figure 20. Plan and profile view of a typical western rivers sternwheeler (after Petsche 1974).

Used infrequently, except on small vessels, until after the Civil War, stern-wheeler propulsion replaced side-wheelers in the post-bellum decades due to "(1) the removal of the paddle-wheel from its recess in the stern; (2) the application of two engines to cranks fixed at right angles to

each other at opposite ends of the paddle-wheel shaft; (3) the incorporation of the paddle-wheel assembly in the hog-chain system; and (4) the introduction of the multiple balance rudder" (Hunter 1949:172-173). By 1880 the stern-wheeler, cheaper to build, more effective in low water than side-wheeler and more economical, had established itself as the dominant vessel type on the rivers of the interior (see Figure 20).

Though less romanticized than the steamboats which plied the bay and rivers, one of the most prolific class of vessels found on the area waters were the schooners. These included large blue-water schooners, coastal schooners, and locally built fishing schooners. Figure 21 shows a three-masted lumber schooner with a full cargo shortly after the turn of the century. These large schooners played a significant role in the local economy as lumber and lumber products such as staves and shingles were one of the main exports from the area.

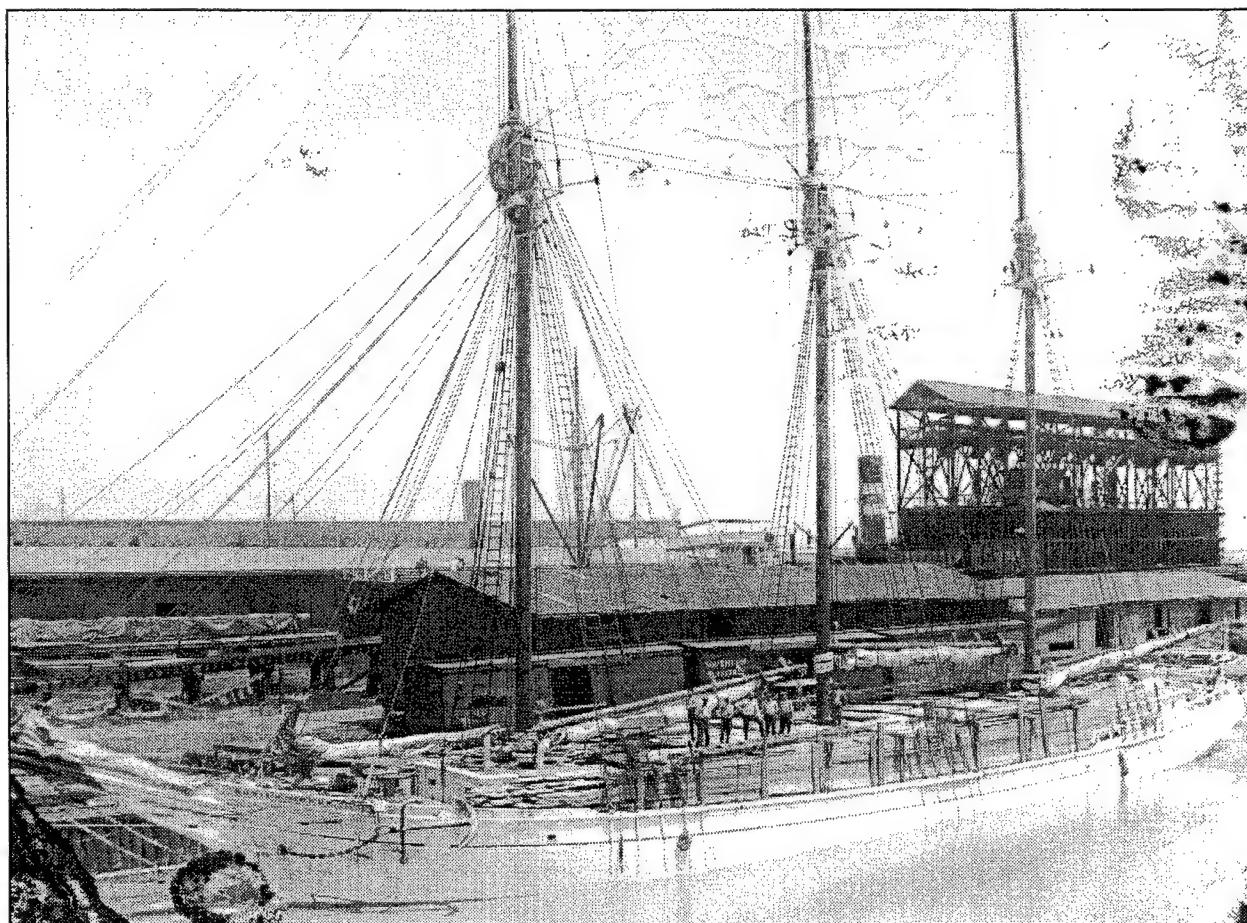


Figure 21. Photograph of a triple-masted lumber schooner fully loaded at Mobile Bay (courtesy of Overby Collection, University of South Alabama Archives).

Another type of schooner used in the area was the light-drafted coasting schooner. Flat-bottomed with a centerboard, it was designed to operate in the shoal water situations prevalent along the Gulf Coast waters and bays. Figure 22, a plan of the Bethune Blackwater Schooner, is representative of this now-extinct type. Archaeologically documented in the Blackwater River near Pensacola Bay, Florida, the Bethune Schooner was involved in the lumber and brick industry which flourished in Pensacola (Duff and James 1994:54).

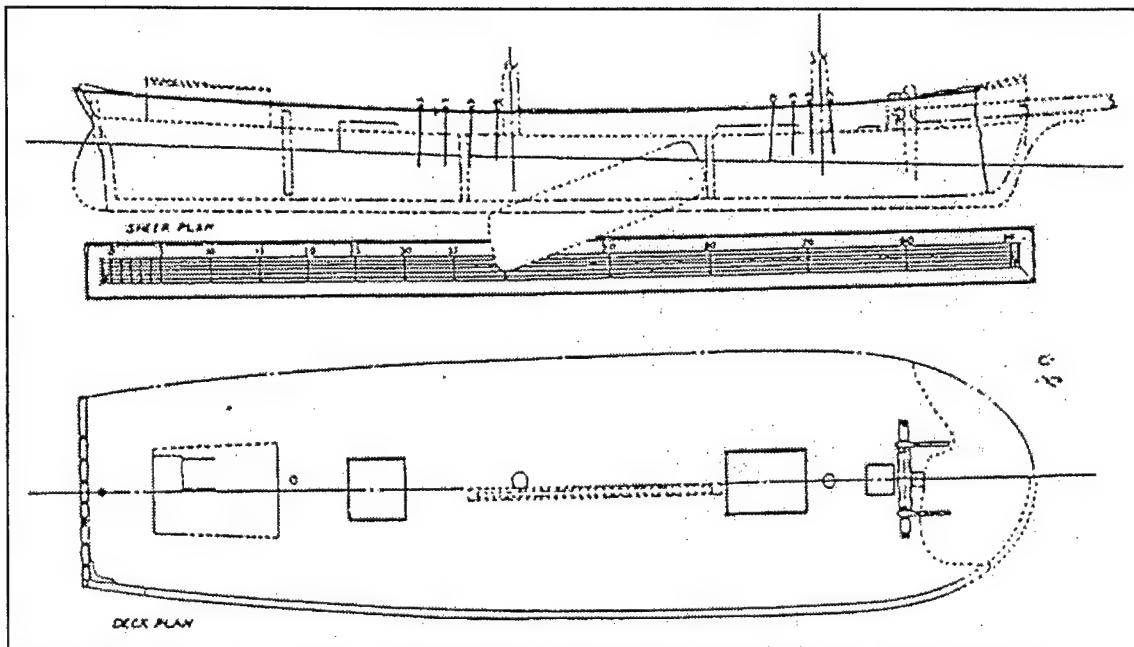


Figure 22. The double-masted Bethune Blackwater Schooner (as presented in Baumer 1990).

In 1937 offshore shrimp grounds were discovered, and vessels called shrimp trawlers began to be built, initially of wood, and after 1945, of steel. In the late 1930s, Florida fishermen:

introduced the “South Atlantic Trawler” when the potential for offshore shrimping in the Gulf was discovered. Begun as a variation of a powered vessel originally derived from the design of Greek sponge boats used on the west coast of Florida, the South Atlantic shrimp trawler generally measured between 50 and 65 ft. long. The shrimp boat reached its present characteristic form and style in the very short period of time between the end of World War II and about 1950. Possibly as a result of the need for maximum rear deck working space, it was among the first powered fishing craft to have a forward-located pilot house. The hull, however, retained characteristics of the old Greek sponge boats with its full body, sweeping sheer line, and fine entrance (Pearson et al. 1993:114).

The small versions of this type, commonly called “shrimp trawlers,” “bay shrimpers,” or “shrimp boats,” can still be found fishing the upper harbor in and adjacent to the project area. Generally these vessels, because of their relatively recent age, would not be considered historically significant if their remains were encountered in the project area. However, the earliest examples of this vessel type might be considered significant relative to National Register of Historic Places criteria based on their evolving yet distinctive construction characteristics.

Besides the vessels employed to carry the products of the major industries in the Pascagoula area, there were a number of utility vessels which were used in day to day activities, including tugboats, pilot boats, river and sound freighters, sloops, catboats, launches, skiffs, and dugouts (Mistovich et al. 1983:46).

Typical of the tugboat was the iron-hulled *Leo*, built in 1882 in Philadelphia. It was a steam powered, single screw vessel 83 feet in length, 19 feet in beam, and seven feet deep from deck to keel (United States Bureau of Customs 1889:306). It followed the typical tugboat morphology, with a forward wheelhouse and center engine room and stack. A locally constructed tug, the *Eva*, was similar in construction, with a 56 foot length, 16 foot beam, and 4 1/2 feet from deck to keel (Mistovich et al. 1983:46).

Sailboats, usually sloop or cat rigged, were used both for work and recreation and were built and used in many areas of the Gulf Coast, including Pascagoula. The catboat was popular around the turn of the century for use in organized sailing races. It has since faded from popularity, and the sloop rig is now the popular choice of small recreational sailboats (Mistovich et al. 1983:46-47).

Two types of small vessels were used all over the Gulf Coast area for fishing, recreation, and short distance transportation of people and goods. Small engine-powered launches, like the one pictured in Figure 23, were common means of over-water transportation in the late nineteenth and early twentieth centuries, being used for general recreation and ferrying. Most were around 35 feet in length with a narrow hull and typically employing a canvas or wooden canopy. Small oar-powered skiffs, which were sometimes rigged with a sail, were often used in the same manner (Mistovich et al. 1983:47).

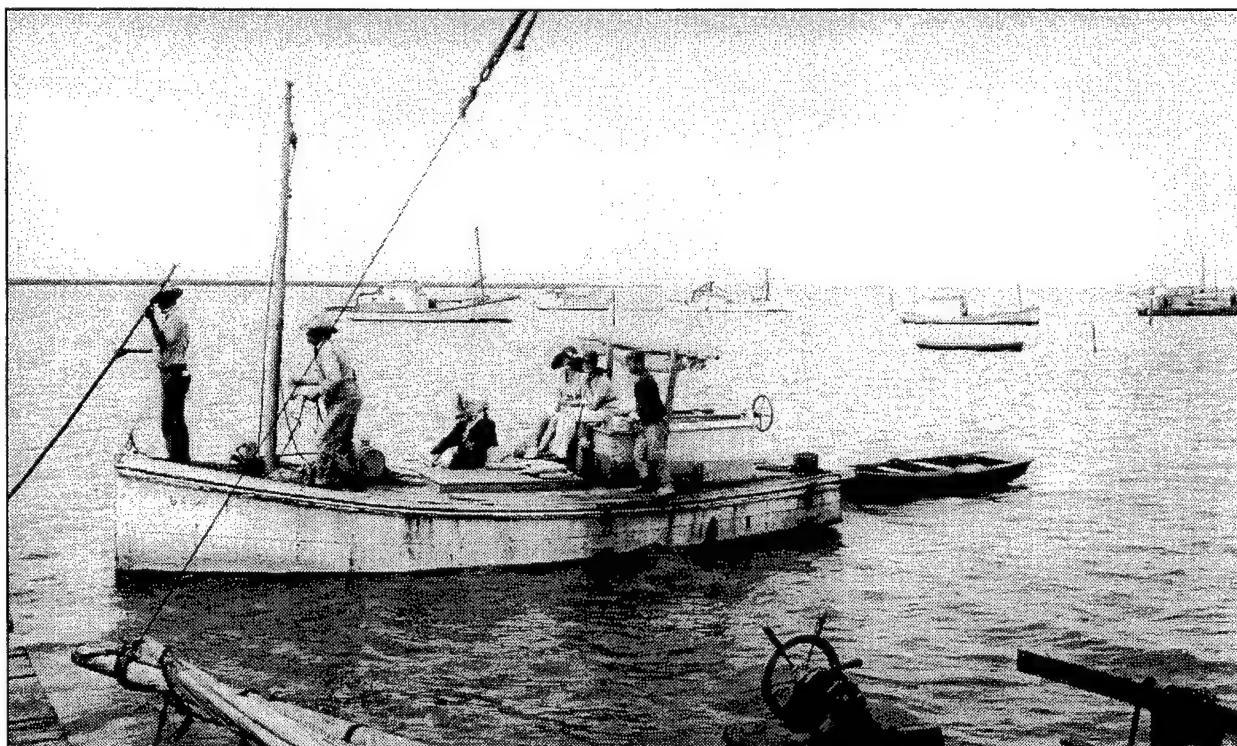


Figure 23. Early twentieth-century photograph of a small vernacular craft. Note passengers on naptha launch and towed bateau (courtesy of University of South Alabama Archives).

METHODS

Personnel

The personnel involved with this remote-sensing survey and target identification had the requisite experience to effectively and safely complete the project as proposed. Stephen R. James, Jr. served as the underwater project manager with Michael C. Krivor serving as principal investigator. Jim Duff, Greg Cook, Andy Lydecker and Jason Raupp rounded out the Panamerican team as both remote-sensing specialists and divers. Captain Mike Howell and first mate Steve Borgen served as boat captain and boat handler aboard the *Manana*. Mike House with the USACE, Mobile District served as Dive Safety Officer (DSO) during the current investigation (Figure 24).

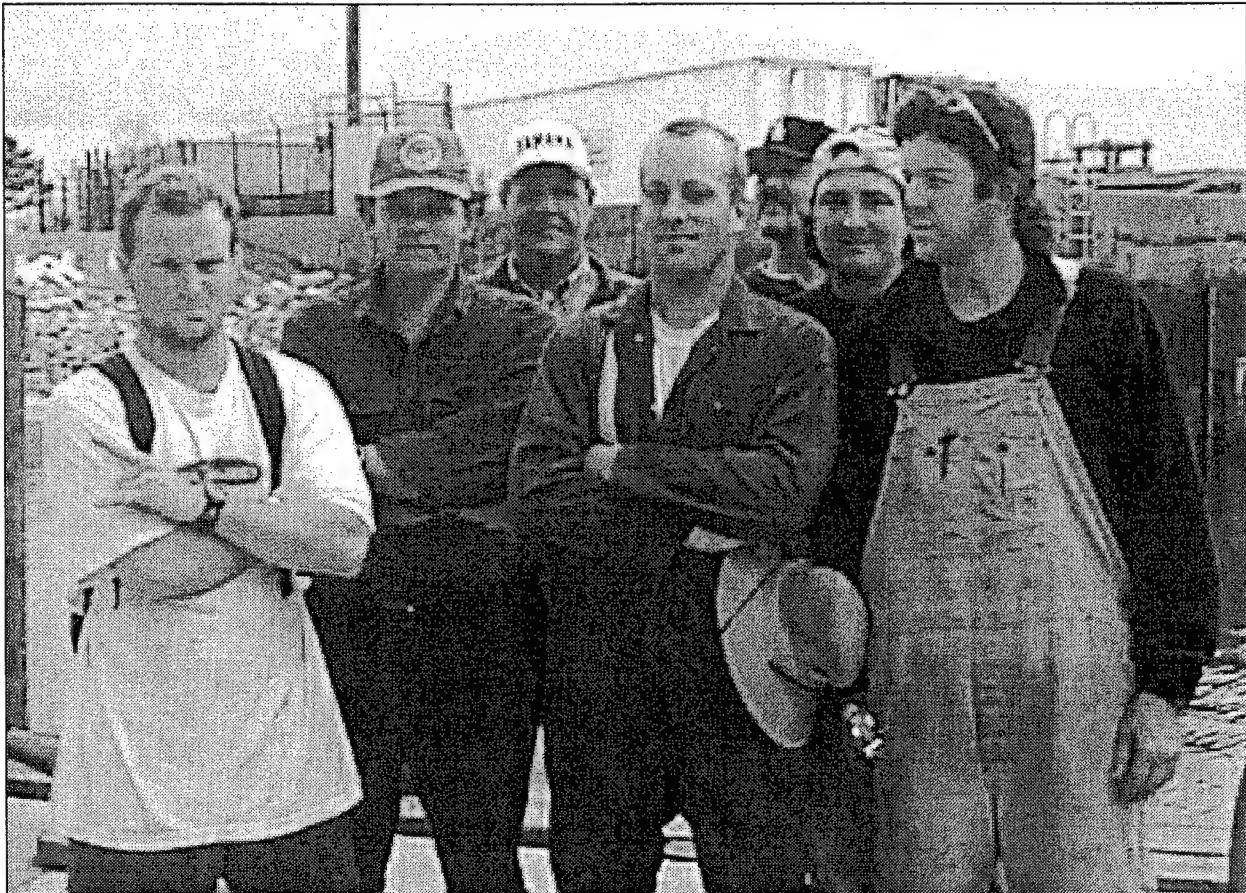


Figure 24. Crew photograph. From left to right: Jason Raupp, Jim Duff, Mike House, Andy Lydecker, Steve Borgen, Greg Cook, Michael Krivor. Not pictured: Captain Mike Howell.

Survey Vessel

The survey vessel used during the refinement survey and dive operations was a 53-foot, steel-hulled trawler (Figure 25). The *Manana* was well suited for remote-sensing refinement work and dive operations. Deck area was available for the placement and operation of the necessary remote-sensing equipment and all dive equipment. The *Manana* conforms to all U.S Coast Guard specifications according to class and had a full complement of safety equipment. The vessel carried appropriate emergency supplies including lifejackets, spare parts kit, tool kit, first-aid supplies, flare gun, and air horns.

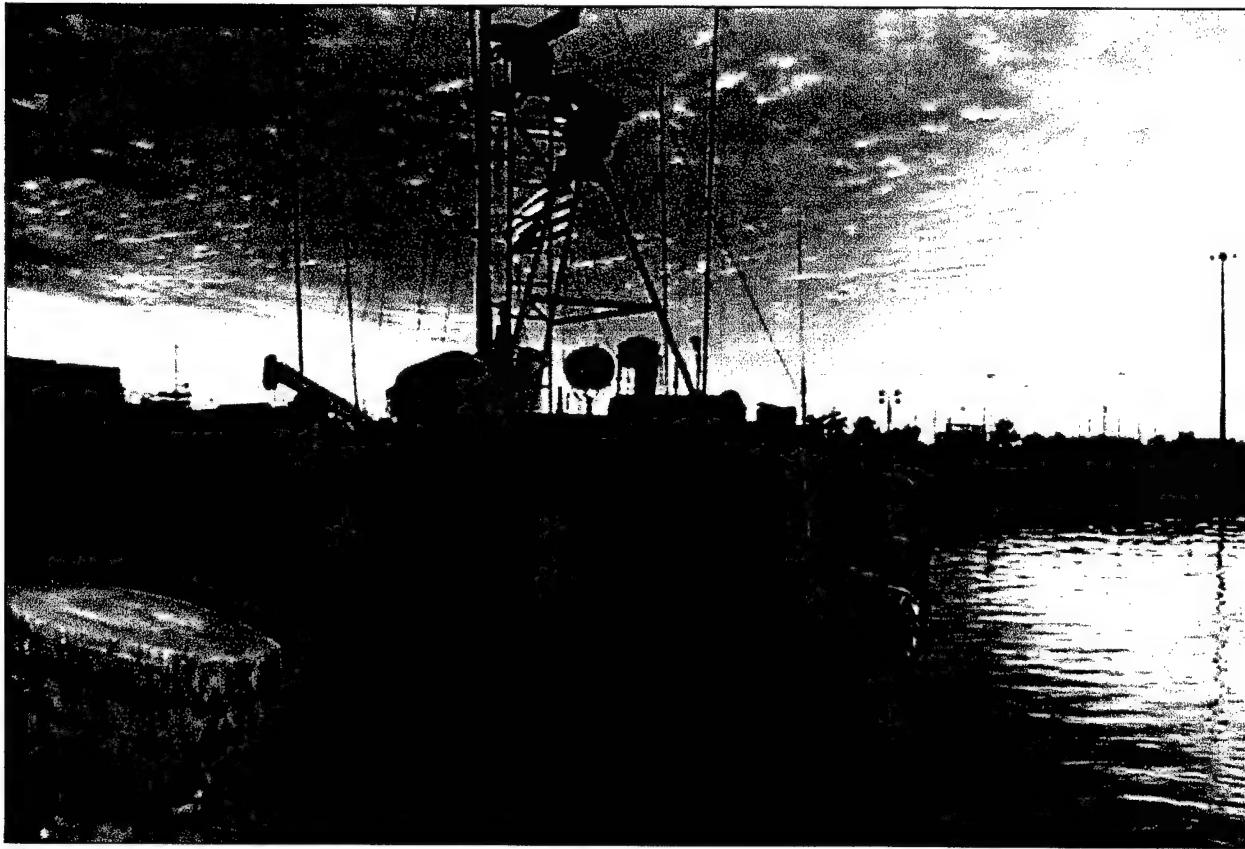


Figure 25. The 53-foot, iron-hulled trawler *Manana*.

Remote-Sensing Survey Equipment

The remote-sensing survey was conducted with equipment and procedures intended to facilitate the effective and efficient search for magnetic anomalies and acoustic targets and to determine their exact location. The positioning system used was a Motorola LGT-1000 Global Positioning System (GPS) instrument linked to a Starlink MRB-2A, MSK Radiobeacon receiver for differential (DGPS) capabilities. Remote-sensing instruments included an EG&G Geometrics Model G-866 recording proton precession magnetometer, with an EG&G Geometrics Model G-801 marine sensor towed off the stern of the *Manana*. A Marine Sonic Technology Sea Scan PC Side Scan Sonar was used to create a near-photographic sonar image of the harbor floor.

Differential Global Positioning System

A primary consideration in the search for acoustic targets and magnetic anomalies is positioning. Accurate positioning is essential during the running of survey tracklines, and for returning to recorded locations for supplemental remote-sensing operations. These positioning functions were accomplished on this project through the use of a Motorola LGT-1000 global positioning system.

The Motorola LGT-1000 is a global positioning system that, when linked to the Starlink MRB-2A, MSK Radiobeacon receiver, attains differential capabilities (Figure 26). These electronic devices interpret transmissions both from satellites in Earth's orbit and from a shore-based station to provide accurate coordinate positioning data for offshore surveys. The Motorola system used here has been specifically designed for survey positioning. Mississippi State Plane coordinates, based on the 1927 North American Datum (NAD 27) coordinate system (used during the McGehee et al. 2000 survey), were used for this project. This positioning was provided through virtually continuous real-time tracking of the moving survey vessel by utilizing

corrected position data provided by an on-board GPS which processed both satellite data and differential data transmitted from a shore-based GPS station utilizing Radio Technical Commission for Maritime Services (RTCM) 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position. Transmitting the differential that corrected the difference between received and known positions, the DGPS aboard the survey vessel constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel.

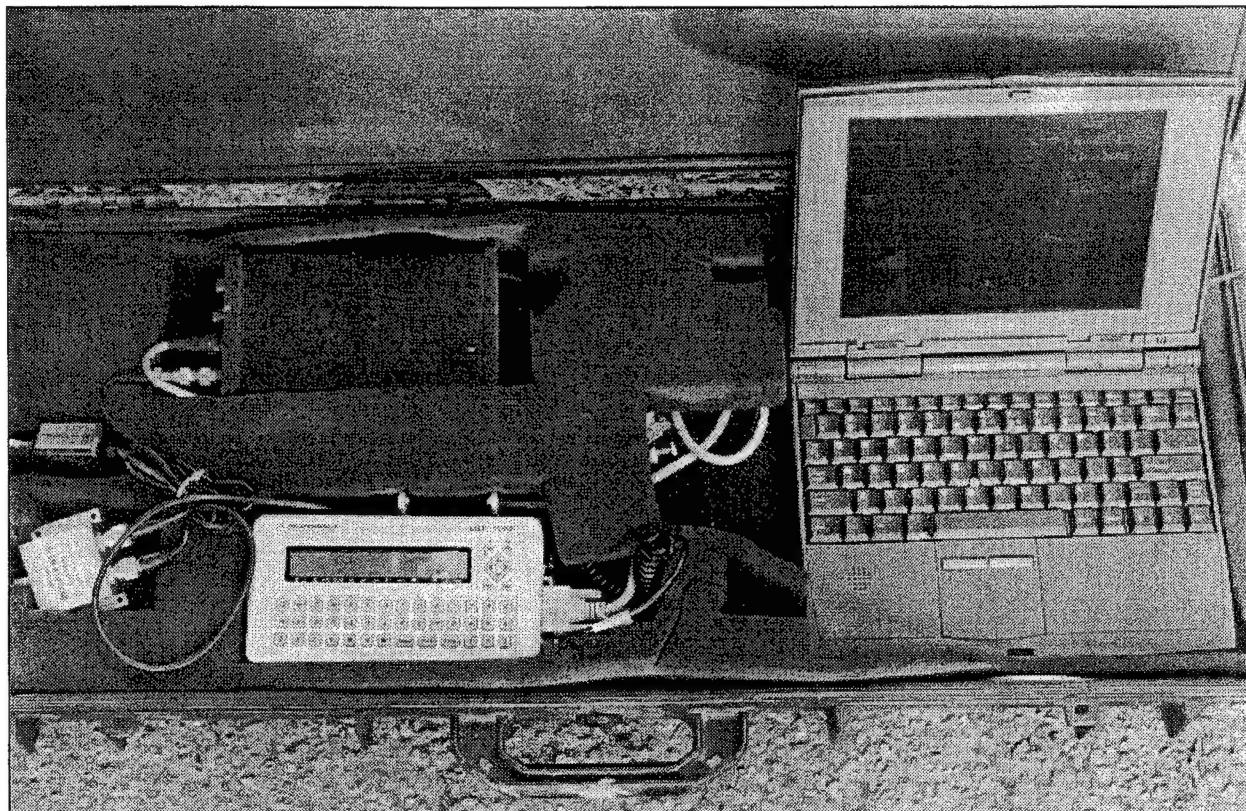


Figure 26. Motorola LGT-1000 global positioning system.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into a Winbook XP computer with an auxiliary display screen aboard the survey vessel. The computer and associated hardware and software calculated and displayed the corrected positioning coordinates every second and stored the data every two seconds. The level of accuracy for the system was considered at ± 1 meter throughout the survey. Computer software (Navtrak[®]) used to control data acquisition was written and developed by Chris Ransome & Associates (CRA) specifically for survey applications. Positioning information was printed on hard copy and stored on magnetic disk aboard the survey vessel. It was used to provide real-time trackline data for the vessel operator during remote-sensing survey operations.

All positioning coordinates are based upon the position of the antenna of the DGPS. Each of the remote-sensing devices was oriented to the antenna, and their orientation relative to the antenna (known as a lay back) was noted. This information is critical in the accurate positioning of targets during the data analysis phase of the project. The lay back of the sidescan sonar was 2 feet port, 40 feet aft, and the magnetometer sensor lay back was 130 feet aft.

Magnetometer

The remote-sensing instrument used to search for ferrous objects on or below the harbor floor of the survey area was an EG&G Geometrics Model G-866 proton precession magnetometer linked to an EG&G Model G-801 marine sensor (Figure 27). The magnetometer is an instrument that measures the intensity of magnetic forces. The sensor measures and records both the Earth's ambient magnetic field and the presence of magnetic anomalies (deviations from the ambient background) generated by ferrous masses and various other sources. These measurements are recorded in gammas, the standard unit of magnetic intensity (equal to 0.00001 gauss). The stripchart printout of the G-866 recorded data at two-second intervals both digitally and graphically, providing a record of the ambient background field and the character and amplitude of anomalies encountered. This information was also stored in the navigation computer.

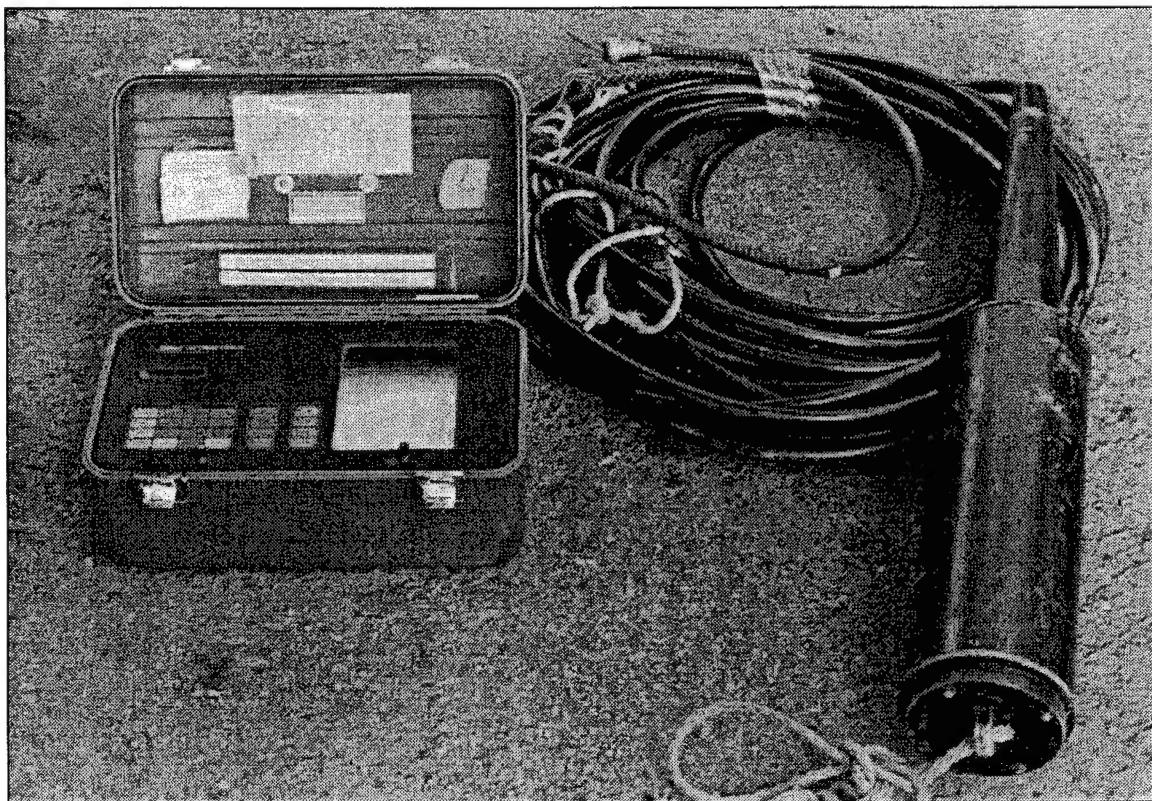


Figure 27. The EG&G model G-866 proton precession magnetometer.

The ability of the magnetometer to detect magnetic anomalies, the sources of which may be related to submerged cultural resources such as shipwrecks, has caused the instrument to become a principal remote-sensing tool of marine archaeologists. While it is not possible to identify a specific ferrous source by its magnetic field, it is possible to predict shape, mass, and alignment characteristics of anomaly sources based on the magnetic field recorded. It should be noted that there are other sources, such as electrical magnetic fields surrounding power transmission lines, underground pipelines, navigation buoys, or metal bridges and structures, that may significantly affect magnetometer readings. Interpretation of magnetic data can provide an indication of the likelihood of the presence or absence of submerged cultural resources. Specifically, the ferrous components of submerged historic vessels tend to produce magnetic signatures that differ from those characteristic of isolated pieces of debris. While it is impossible to identify specifically the source of any anomaly solely from the characteristics of its magnetic signature, this information in conjunction with other data (historic accounts, use patterns of the area surveyed, visual inspection), other remote-sensing technologies, and prior knowledge of similar targets, can lead to an accurate estimation.

For this project the magnetometer was interfaced with a Winbook XP laptop computer, utilizing Navtrak® software applications for data storage and management. It was also interfaced with the positioning system, allowing positioning fix points to be included on the stripchart printout.

Sidescan Sonar

The Marine Sonic Technology (MST) Sea Scan Side Scan Sonar is a self-contained sonar system (Figure 28). The software included with the Sea Scan Personal Computer (PC) system controls the collection of sonar imagery, as well as navigational input, and displays the information to the operator in the form of a digital display (utilizing a 13-inch color monitor). The Sea Scan PC allows the operator to view wide tracts of the ocean bottom by sonifying along a predetermined swath width and recording the strength of the echoes from the sea bottom. This is performed by a towfish, which is towed just above the harbor bottom by a tow cable. The towfish emits a continuous, narrowly focused beam of sound perpendicular to the path of forward motion. The sound pulses pass through the water and are reflected by the harbor bottom and from various objects such as shipwrecks, debris, and geographic features (sand ripples, rocks, etc.). The strength of the signal returned to the towfish is recorded, and then the entire sonar record line is drawn onto the screen for viewing by the operator, constructing an image of the harbor floor line by line.

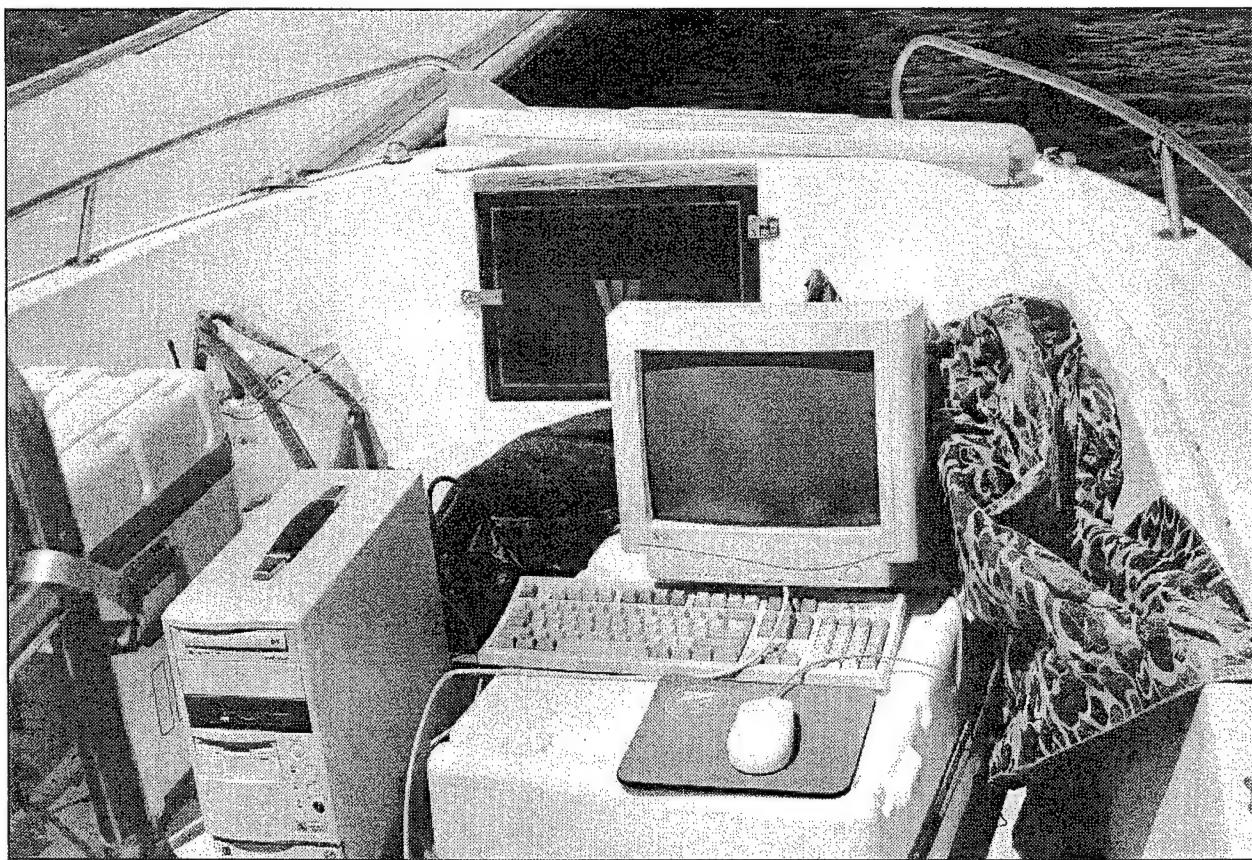


Figure 28. Sidescan sonar system employed during the project.

The MST Sea Scan PC sidescan sonar was linked to the towfish that employed a 600-kHz power setting and a variable side range of 20 to 50 meters per channel on each of the tracklines run. The power setting was selected in order to provide maximum possible detail on the record generated; 600 kHz was the preferred frequency. The variable side range of 20 to 50 meters was switched frequently either to enhance resolution of target areas (20 meter) or to examine wider swaths of the harbor floor (50 meter).

Refinement and Survey Procedures

Coordinates for each of the three magnetic targets and six sidescan sonar targets identified by McGehee et al. (2000) were entered into the navigation computer. Beginning with magnetic Target 4 and proceeding sequentially through magnetic Target 6, each was refined with the magnetometer after a buoy was dropped at each prescribed location. Once the magnetometer and DGPS were tested, the running of tracklines began. A series of 300-foot long tracklines, spaced approximately 50 feet apart, was run over the target area to determine the exact location of the target around the buoyed location. Three tracklines were run on a north/south heading followed by three tracklines running east/west for complete coverage of each target location (Figure 29).

The helmsman viewed a video monitor, linked to the DGPS and navigational computer, to aid in directing the course of the vessel down the pre-plotted tracklines. The monitor displayed the pre-plotted trackline, the real time position of the survey vessel relative to the pre-plotted trackline, and the path of the survey vessel. The speed of the survey vessel was maintained at approximately three to four knots for the uniform acquisition of data.

As the survey vessel maneuvered down each trackline, the navigation system monitored the position of the survey vessel relative to the pre-plotted tracklines every two seconds, each of which was recorded by the computer. Event marks were hand annotated on the magnetometer strip chart delineating the start and end of each of the tracklines. The exact time of both the start and end of line was also recorded to aid in producing magnetic contour maps.

Following the completion of each magnetometer refinement survey, a review of the data was conducted to determine the presence or absence of each target within the refinement area. If the data indicated that a magnetic target was present within the refinement area, a series of additional tracklines with the magnetometer was undertaken to localize the anomaly and an additional buoy placed at the source of the target. The *Manana* was then anchored close to the source of the anomaly and readied for dive operations.

Following the refinement (and identification) of the three magnetic anomalies, each of the six sidescan sonar targets were investigated starting with Target 22B and proceeding through Target 76A. Once a buoy was placed on the target location the sidescan sonar was deployed and a series of tracklines run over the target area. An example of a sidescan sonar image obtained near Target 33C clearly shows two crab pots and the buoy weight and line (Figure 30). Once enough data was collected at each target location, the dive platform was anchored close to the buoyed location and readied for dive operations.

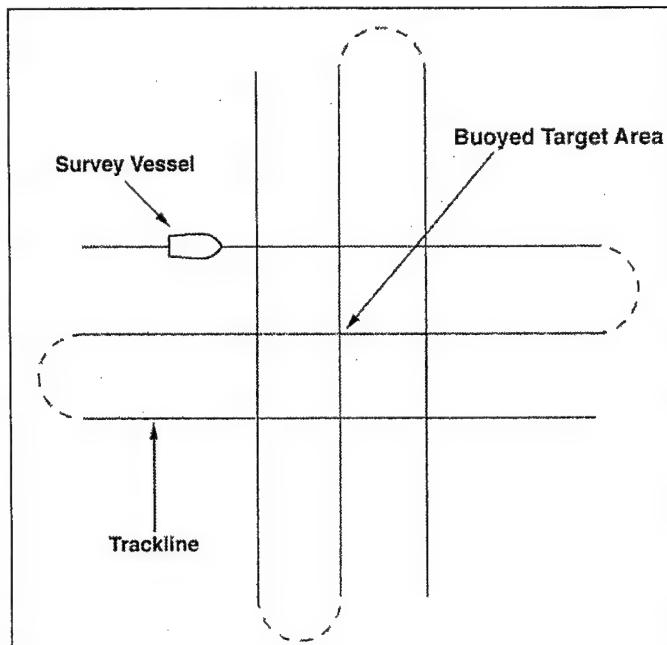


Figure 29. Refinement pattern run over the magnetic anomaly locations during the current investigations.

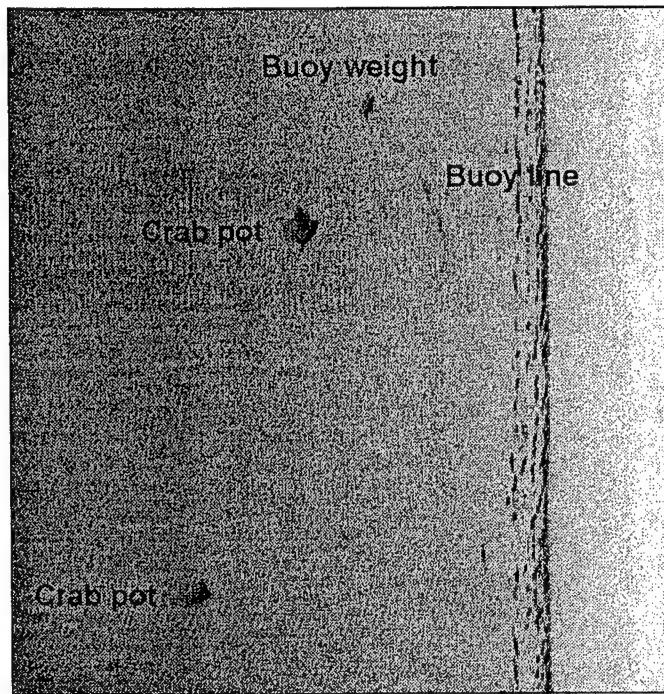


Figure 30. Sidescan sonar image of two crab pots, buoy weight and line.

Dive Operations

Once the target locations were refined the next phase of the project was to attempt to locate the source of the anomaly either through visual or tactile methods. Prior to diving, the direction of the tidal current and wind direction, relative to each target area, had to be ascertained. The ebb and flow of the tide and wind direction determined the orientation of the survey vessel and affected the deployment of tools the diver would utilize on the harbor floor. Anchors were then deployed to hold the survey vessel over the target area, thus allowing the diver safe entry and exit from the stern of the vessel.

Surface Supplied Air (SSA) was chosen as the most efficient and safe method of conducting investigations within the project area. Divers employed a Kirby-Morgan Superlite-17 dive helmet connected to a surface-supplied air source, radio communications cable, safety tether, and pneumo hose (Figure 31). On the surface various individuals and pieces of equipment ensured safe diving operations. A dive tender was required to aid the diver in donning and doffing equipment and to tend the diver while submerged and moving about the harbor bed. The radio communications operator kept in constant contact with the diver and relayed messages between the diver and the surface support team. A standby diver was required on site in the advent of any emergency situation that would require aid to the primary diver. Finally, a dive supervisor was present on site at all times to coordinate the activity of the diver and surface support team to achieve the project goals.

The initial objective for the diver was to visually inspect the harbor floor for the source of the anomaly prior to conducting any probing activity. The diver was first directed to the buoy located over the anomaly. If the source of the anomaly was not observable on the surface of the harbor floor a series of arcs was conducted by the diver to adequately cover the target area. If the target was still not acquired the diver was given a probe to help locate the buried anomaly. Once the target was located, a buoy was placed near the middle of the target area and a series of transects were run at cardinal points (north, south, east, west) to determine its overall extent.



Figure 31. Diver suited and ready to begin dive operations.

Underwater Probing

Probing of anomalies is an effective means of determining the spatial extent and burial depth of a given target located beneath the sea floor. Probes were typically spaced at five to 10-foot intervals during the investigation. If a positive return was encountered, probing distances were refined in an effort to outline the size of the return. Probes were placed at all cardinal points to further delineate any positive returns.

RESULTS

The refinement survey and diver investigations of nine targets located within Pascagoula Harbor was intended to relocate and identify any potentially significant submerged cultural resources which may require additional investigations prior to proposed future dredging operations. The survey was completed in an effort to identify those targets which might be eligible for inclusion into the NRHP. A magnetometer and sidescan sonar survey completed of the area in 2000 (McGehee et al. 2000) identified nine potentially significant targets within the project area. These previously located anomalies were the focus of the current investigation.

Table 1. Potentially Significant Targets Located Within Pascagoula Harbor.

Target	Northing	Easting	Description
4	245800	582500	Maximum deflection of 100 gammas; correlates with sidescan sonar target 55J
5	245500	582700	Cluster of magnetic anomalies; magnetic deviation of 160 gammas
6	245800	583100	Three large magnetic anomalies; Magnetic deviation exceeding 120 gammas
22B	245580	583590	Larger, linear single target
33A	245600	583610	Large single target
33C	245590	583230	Medium point target
55B	245800	583550	Larger single target
55J	245820	582580	Cluster of larger targets
76A	246020	583510	Large (over 10 ft) curvilinear

(after McGehee et al. 2000:32-34)

Once a target was adequately refined, the dive boat was anchored near the target location with the buoy located off the stern. After anchoring the vessel a diver suited up and prepared to enter the water. Upon reaching the bottom the diver took a depth reading to determine the amount of bottom time allowable for the diver. The diver was then directed to the buoy in an effort to locate the source of the anomaly. If the anomaly was not exposed above the ocean bottom near the buoy, the diver was instructed to swing in a series of arcs to either side of the buoy with a hand-held probe. Once the target was located an additional buoy was placed at the center of the magnetic or sidescan sonar source for refinement numbers. The following represents the findings and identification of each of the nine targets investigated by Panamerican.

Target 4

McGehee et al. describe magnetic Target 4 as “located near the center of the northern survey area, Anomaly 4 is actually a cluster of small anomalies. The eastern-most anomaly, with a maximum gamma deviation of 100 gamma, correlates with side scan target 55J, a cluster of 3 or 4 acoustic targets 1-to-3 feet in dimension” (2000:34).

A buoy was placed over coordinates provided by McGehee et al. (2000) in approximately 25 feet of water. Refinement of the target with the magnetometer produced a 30-gamma dipole anomaly (Figure 32). A total of six transects were run over the area before the target was adequately refined near the original buoy location. The maximum gamma deflection (100 gammas) recorded by McGehee et al. (2000) could not be recreated during the current investigation. This may indicate that some of the original magnetic targets at this location have been removed since the original remote-sensing survey in May 2000.

Investigation of the target commenced with the diver locating the buoy weight and placing probes at five-foot intervals in the four cardinal locations (north, south, east, west). After the

source of the anomaly was not immediately located the diver was instructed to begin diver sweeps of the area around the buoy, dropping probes into the sediment at five-foot intervals. Within half an hour the diver identified the source of the anomaly as a twisted piece of iron sheet metal (Figure 33). The metal piece was approximately 3 1/2 feet in length and two feet wide and was brought to the surface by the diver. The plating is about 1/4 inch thick. The relative paucity of magnetic targets at this location (with the exception of the small 30-gamma anomaly) would indicate that the piece of iron debris located by Panamerican represents the source of Target 4 (as well as sidescan sonar target 55J). Additional probing and diver arcs in the area identified no other sources of magnetics within the area. Sidescan sonar investigation of the target area after the retrieval of the piece of iron debris did not indicate any other sidescan sonar targets within the general area. This site is not considered significant for the purposes of this investigation.

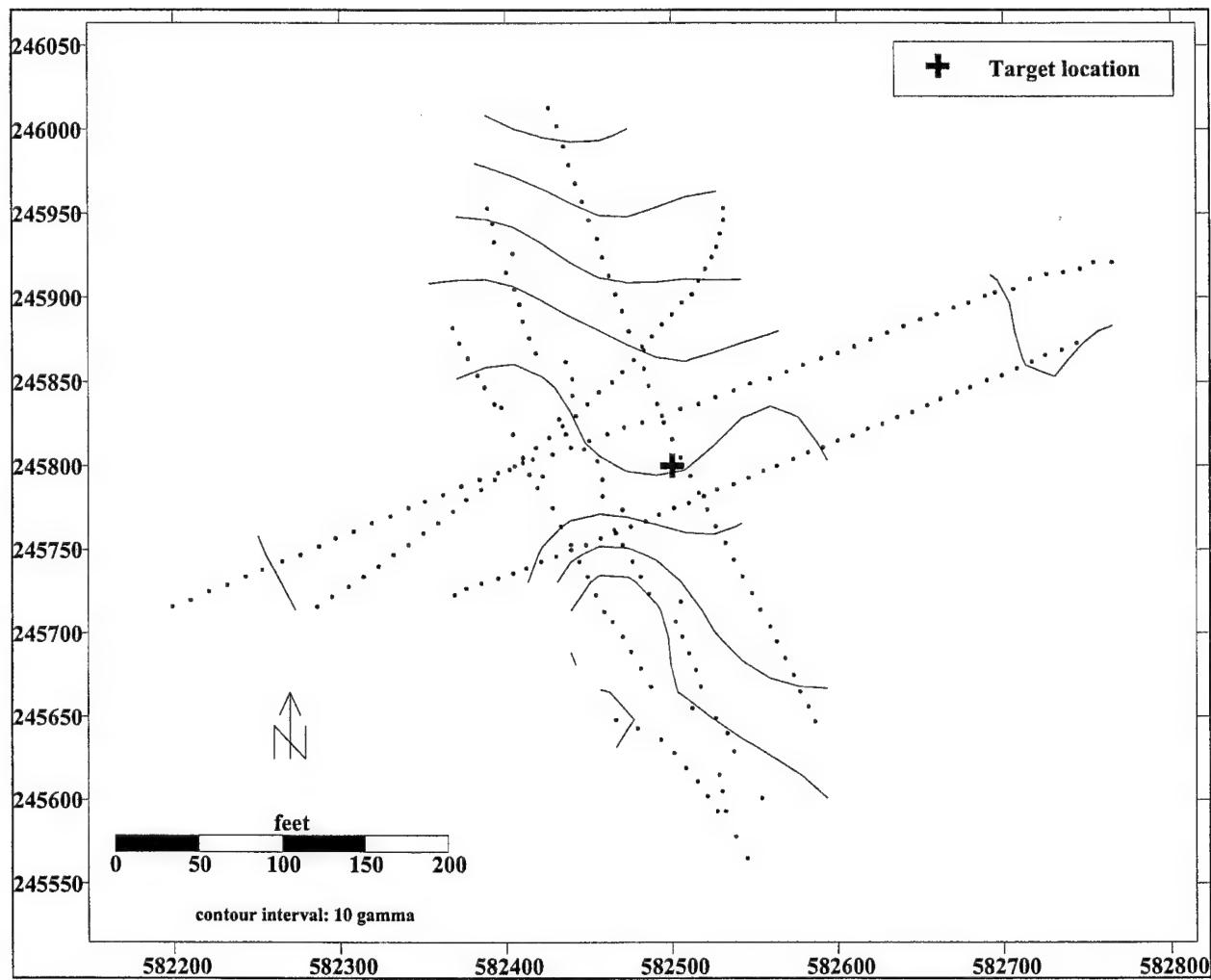


Figure 32. Magnetic contour map of Target 4. Note the relative paucity of magnetics at this location.

Target 5

Target 5 was initially described by McGehee et al. (2000) as a large cluster of anomalies with the main anomaly having a magnetic deviation of over 160 gammas. While it was felt this large anomaly was associated with a corresponding sidescan sonar target (100 feet by 20 feet in dimension), its location outside (to the south) of the project area precluded it from additional investigation. However, McGehee et al. (2000:34-35) did identify a smaller anomaly (likely buried) within the project area boundary.



Figure 33. Twisted iron plating, identified as Target 4, recovered by diver.

After dropping a buoy on the coordinates provided by McGehee et al. (2000) four transects running only east/west were made with the magnetometer (Figure 34). The justification for not running any transects to the north/south was the close proximity of Singing River Island to the south resulting in shallow water depths. Total length of each transect line was 300 feet, spaced at 50-foot intervals. Results of the magnetometer refinement survey identified a relatively small anomaly at the buoyed location as well as a sizable anomaly (approximately 3,000 gammas) to the south. Review of the project area coordinates placed this large anomaly outside the proposed dredge area, therefore this additional target was not investigated during the current investigation.

Diver investigation of Target 5 commenced immediately after the magnetic refinement survey; water depth on site was 24 feet. After locating the buoy weight the diver conducted sweeps in the area after searching the area immediately around the buoy weight. After preliminary arcs around the buoy the diver quickly located a variety of modern debris within close proximity to it. This debris includes a 55 gallon drum, a small cut timber, a large amount of tree limbs/branches, a small section of a wood piling, a small piece of particle board, as well as a kitchen sink. All objects were located within 80 feet of the buoyed location.

Subsequent to diver investigations the sidescan sonar was deployed in the area to determine if the source of the 3,000-gamma anomaly was exposed on the harbor floor. Numerous passes in the area failed to identify any source of the anomaly. During low tide a number of pieces of iron debris were observed near the north shoreline of Singing River Island (Figure 35). Discussions with the Naval Station Pascagoula indicated that Singing River Island is partially manmade and the large amounts of refuse may have been placed in the area intentionally (Tom Sarros, personal communication January 2001).

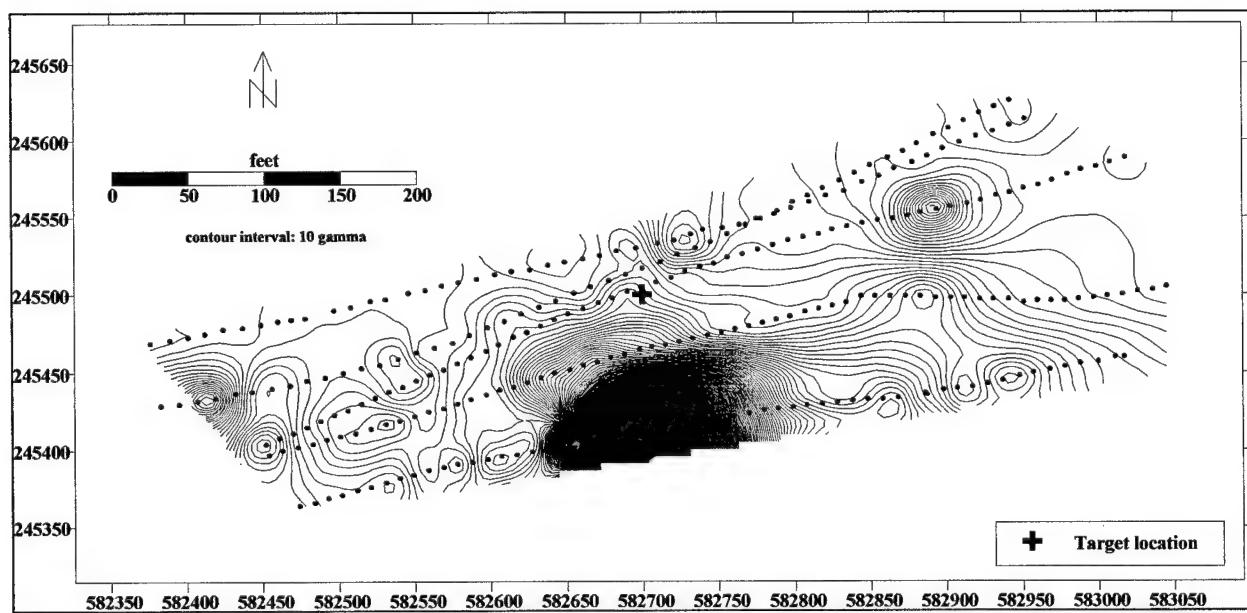


Figure 34. Magnetic contour map of Target 5. Note the large magnetic anomaly (approximately 3,000 gammas) located south of the project area.

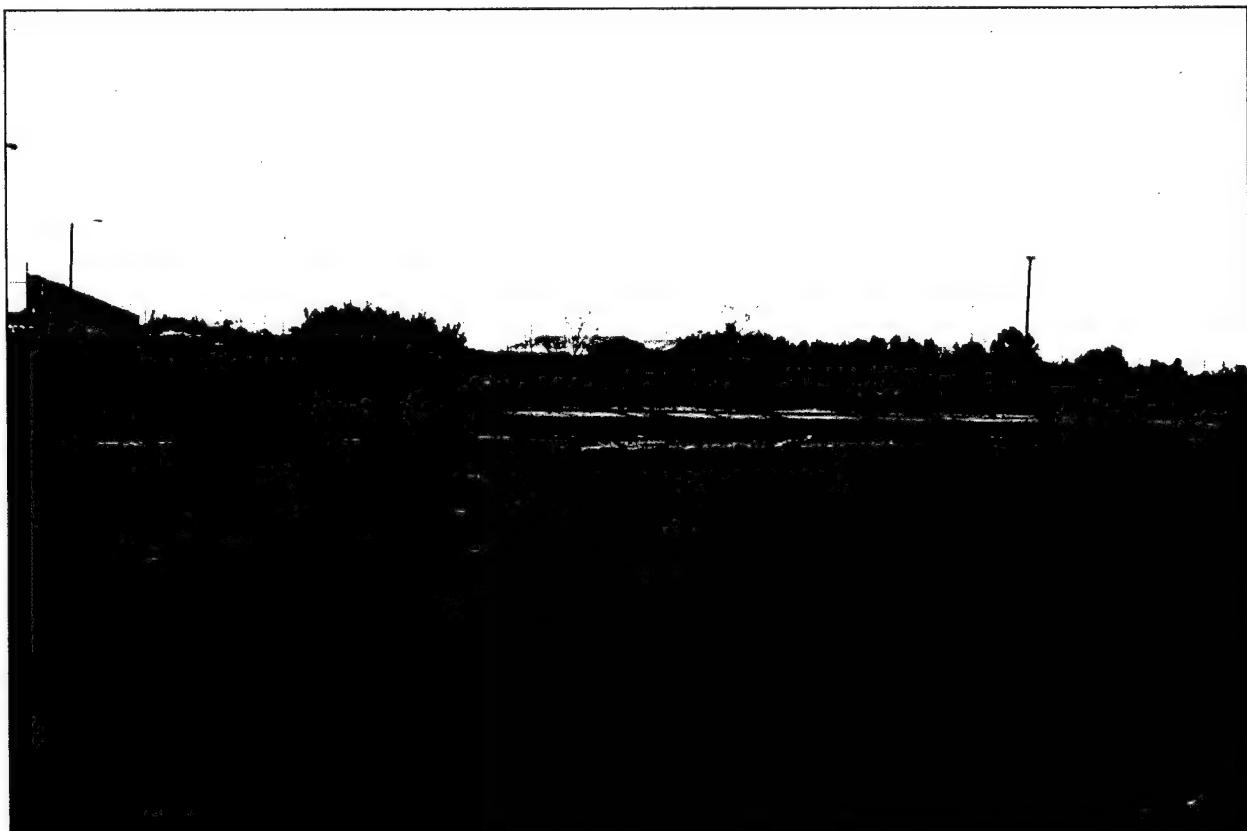


Figure 35. Various pieces of modern iron debris exposed during a period of low water along the north shore of Singing River Island.

Target 6

Target 6 was originally identified as three large magnetic anomalies, “each with a maximum gamma deviation of exceeding 120 gammas...” (McGehee et al. 2000:35). One of the three anomalies had an associated sidescan sonar return (Target 76B). After dropping a buoy on the coordinates provided by McGehee et al. (2000:38), the magnetometer was deployed and a series of eight tracklines run over the target area. Results of the refinement survey identified a cluster of anomalies near the buoyed location (Figure 36). While a larger anomaly was identified to the southwest of the buoy, review of the magnetic data identified it as a single point source only recreated on two passes heading east/west. Since this anomaly represents a monopole and has a relatively short duration, it was decided to investigate the cluster of anomalies located closer to the buoyed location.

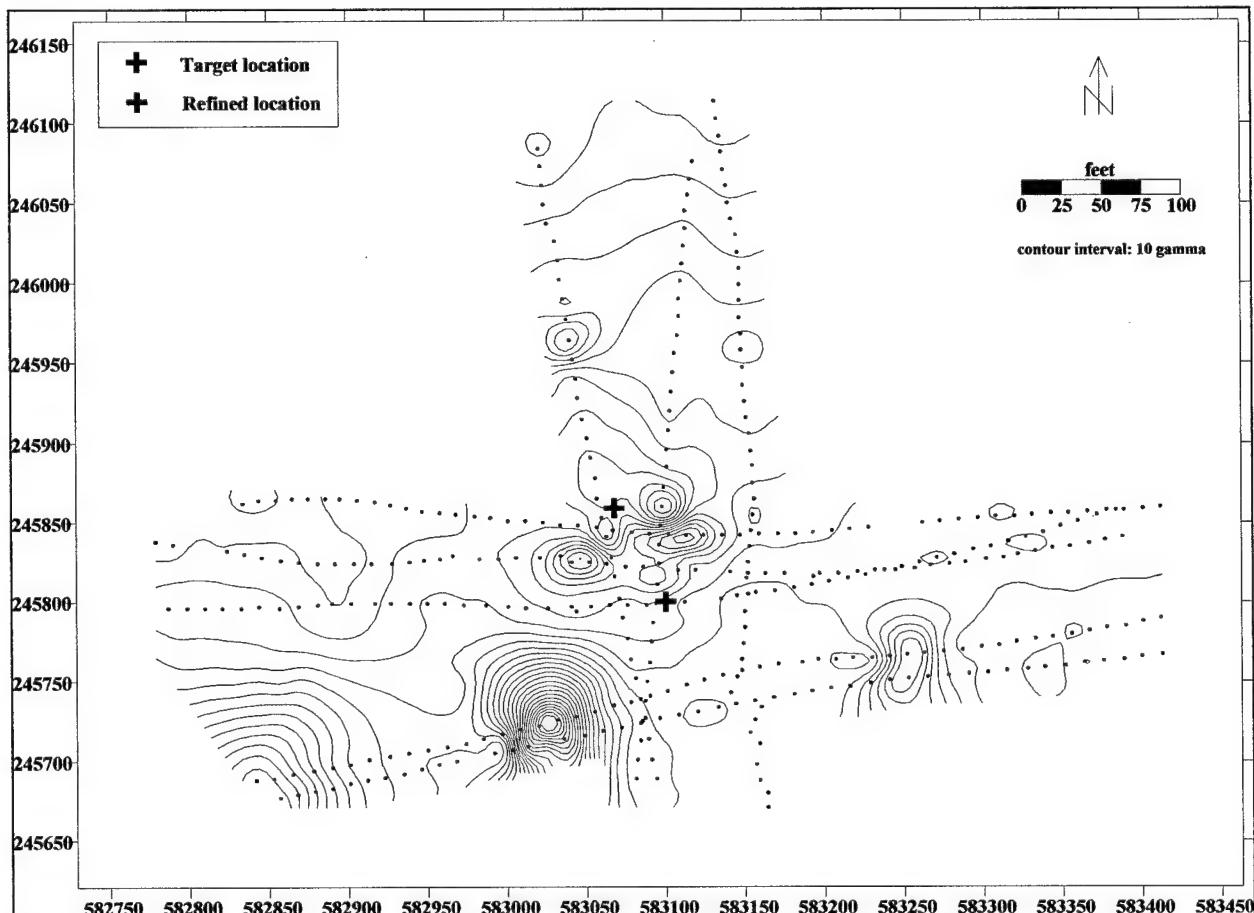


Figure 36. Magnetic contour map of Target 6 showing the multi-component signature of the anomaly location as well as the refined location of the target.

Initial diver investigation of Target 6 failed to identify the anomaly's source even after combing the area with a probe. Water depth on site is 27 feet. Since the source of the anomaly could not be identified during the initial dive it was determined to make a subsequent dive to attempt to locate the source of magnetics. A second dive on Target 6 identified the source of the anomaly as a lengthy section of wire cable slightly buried under the harbor sediment (Figure 37). During the attempt to determine the overall length of cable the diver identified a small coupling joining two sections of the cable together. After following the cable for over 25 feet it was decided that Target 6 simply represents a entangled modern wire cable lying approximately one foot under the harbor floor. Regarding the presence of wire cable in a industrial harbor Irion and Bond state:

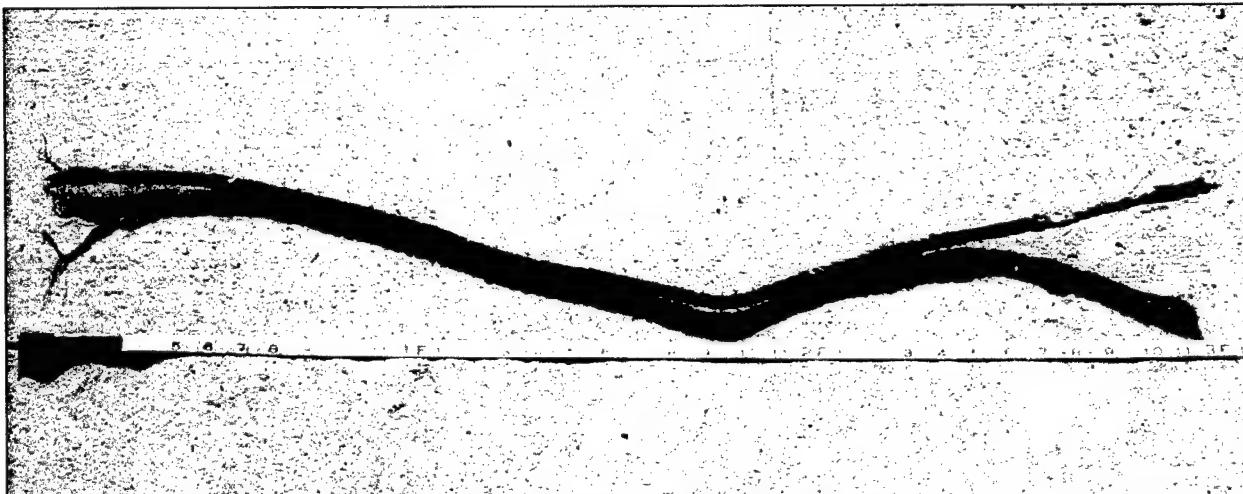


Figure 37. Section of cable recovered by diver, identified as the source of magnetic Target 6.

In a heavily industrialized commercial port, wire cable is utilized in a variety of shipboard activities. In Mobile, it is principally seen on shrimp boats to support the heavy net rigging and, in the case of the heavier cable, on the channel dredges. The large cargo vessels employ cable in lifting cranes and mooring lines. When the cable becomes worn or kinked, it is discarded. This can usually be interpreted as heaving it over the side. Whether through accident or intent, a substantial amount of cable ends up on the bay floor and serves to complicate the magnetic record (1984:88).

Wire cable can be easily missed during diver investigations especially if it has a relatively small diameter or is buried under sediment. The cable identified as Target 6 was only 1/4 inch in diameter. It is considered modern and not significant for the purposes of this investigation.

Target 22B/Target 33A

Due to the close proximity (± 60 feet) of sidescan sonar Target 22B and Target 33A, buoys were dropped on each and a series of tracklines were run concurrently past both buoyed locations. Swath coverage of the area ranged from 20-50 meters depending upon the resolution and distance of the survey vessel to the buoys. Review of the sidescan sonar data provided no identifiable targets within the general area of either target.

Once the sidescan sonar towfish was retrieved the dive vessel was anchored on site and a diver readied for dive operations. Upon entering the water the diver took a pneumo (depth) reading on the bottom which registered 22 feet. Afterwards the diver backed out on his rig and first located the buoy weight for Target 22B. Diver arcs in the area first identified a series of noticeable furrows in the bottom sediment. These furrows are characterized by exposed areas of oyster shell, pieces of which were brought to the surface and photographed (Figure 38). These small furrows were isolated and approximately 5-6 feet in length. Possibly the result of shrimp trawling in the area, or environmental processes, these types of features could be interpreted as potential side scan sonar targets. McGehee et al. describe Target 22B as a "larger, linear single object" (2000:32), which could be represent the furrows described by the diver.

In an effort to cover both target areas the diver continued to arc across the harbor floor, covering an area approximately 200 feet in diameter around the buoyed location(s). Within 60 feet of Target 33A the diver located a 2x6 timber lying exposed on the bottom. The piece of timber (8-10 feet in length) was not associated with any other timbers or cultural material. Continuing to sweep the area the diver located other pieces of isolated debris identified as plastic sheeting, an exposed 15-foot section of PVC piping, and other small pieces of debris. On one of the last arcs

the diver identified a larger furrow than those located at the beginning of the dive. This furrow was almost two feet deep and extended in an east/west orientation for approximately 15 feet. This feature could also represent the source of either Target 22B or 33A.

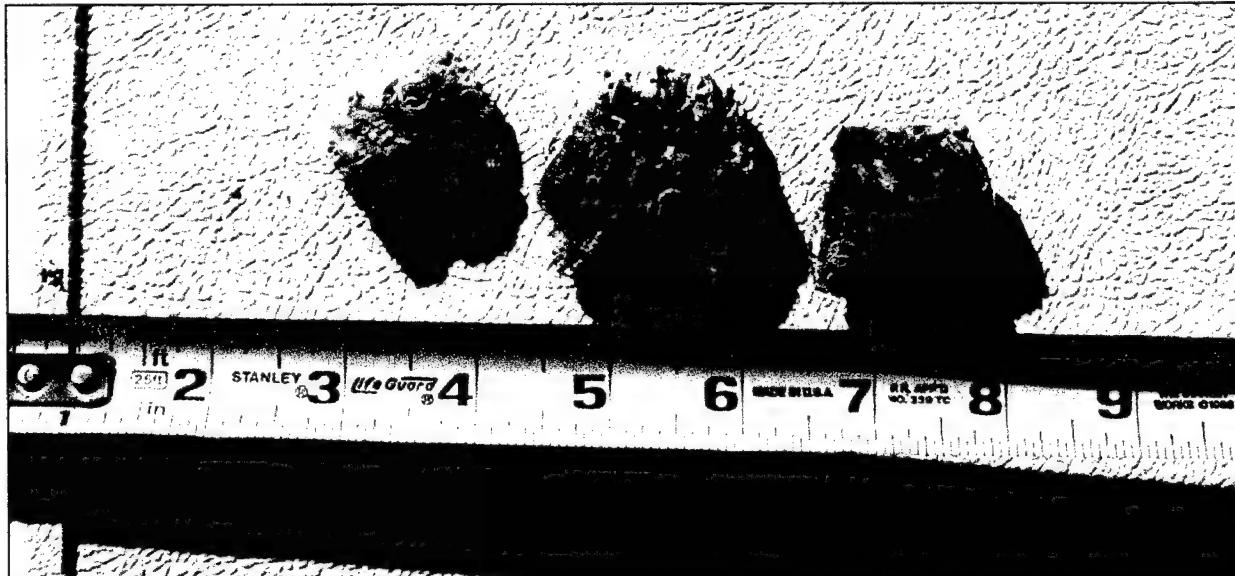


Figure 38. Three small pieces of oyster shell recovered from furrow identified during the investigation of Targets 22B and 33A.

With this said both Target 22B and 33A appear to be the remains of a variety of exposed modern debris, possible shrimp trawler drag scars, and/or environmental features. Regardless of the exact identity of either of the two targets, none of the material identified on the harbor floor near these two targets is considered significant for the purposes of this investigation.

Target 33C

Target 33C was described by McGeehee et al. as a "medium point target" (2000:32). Once a buoy was deployed a series of tracklines was run over the area to determine if the target was still extant. Findings from the sidescan sonar survey indicate a single isolated target, linear in appearance. The object is oriented on an east/west heading and casts a shadow to the north (Figure 39). Once the sidescan sonar towfish was safely onboard the dive vessel was anchored near the target and a diver suited up to investigate the area. A pneumo (depth) gauge reading taken on the harbor floor near the target area was 22 feet.

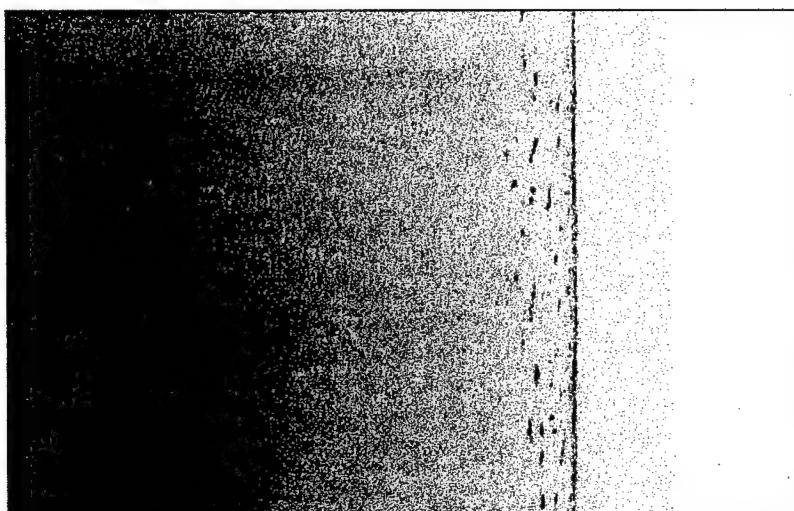


Figure 39. Sidescan sonar image of Target 33C. This target was identified as a channel marker or large road sign projecting straight up off the bottom about two feet.

After searching the area near the buoy weight the diver began sweeps across the bottom at 10-foot intervals. Quickly after beginning arcs the diver soon located a large metallic object projecting out of the sediment. The object was approximately eight feet in length and only 1/8-inch thick. With one side of the object smooth and with rounded edges it was conjectured that it represents either an old channel marker sign or perhaps a road sign (possibly deposited after a hurricane). Since the sign is projecting straight up off the bottom (almost two feet), it is very possible that the object recorded by the sidescan sonar was the shadow, created by the sign protruding off the harbor floor. Additional sweeps in the area failed to locate any other sources of cultural material in the area.

Target 55B

McGehee et al. described Target 55B as a "large singular target" with a confidence level of 10 (2000:32). The confidence level assigned by McGehee et al. (2000) was based on the repeatability of the target on adjacent tracklines. In the "Survey Results and Discussion" section of the original remote-sensing survey the confidence of a given sidescan sonar target was assigned as follows:

A target that was clearly identified from an overlapping image on an adjacent line was rated 9; one that was identified on four or more scans received a score of 10. A target that, because of its location would be expected to [be] visible from an adjacent survey line, but wasn't, had its confidence reduced to 5 (McGehee et al. 2000:29).

Those targets not repeatable on adjacent lines were assigned a confidence level of five whereas those targets repeated were assigned at least a 10. Once a buoy was dropped on the coordinates provided by McGehee et al. (2000), the sidescan sonar towfish was deployed and a series of tracklines run over the target area. Successive passes at the 20-50 meter range produced no identifiable targets at or near the buoyed area (Figure 40). Regardless of the negative remote-sensing findings, the dive vessel was anchored near the target area and readied for dive operations. Once the diver suited up and was on the harbor floor a pneumo-gauge (depth) reading was taken on the bottom which registered 26 feet. To the east of the buoyed location the diver descended down into the current navigation channel which registered at a depth of 34 feet.

After numerous arcs around the target location the diver reported a relatively sterile bottom although intermittent pieces of modern debris (including wire cable and plastic sheeting) were identified in the general area. Continuing to arc to the south the diver identified a number of fragments of modern wire cable within 100 feet of the buoyed location. While one piece was only three feet long a second was approximately 15 feet in length. It is possible that a piece of wire cable extending off the harbor floor could produce a hard return on a sidescan sonar as reported by McGehee et al. (2000). It is the opinion of the principal investigator that no further archaeological investigations are required at this location.

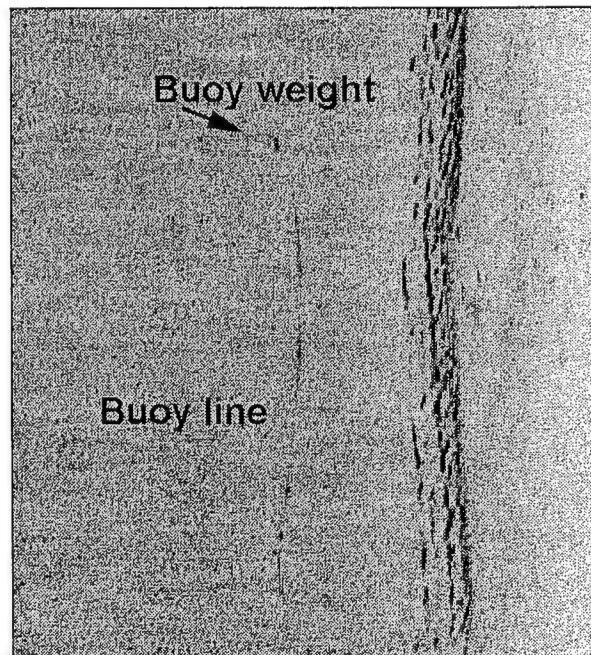


Figure 40. Sidescan sonar image of Target 55B. Note the buoy weight and line and sterile harbor floor.

Target 55J

Located only 20 feet apart on the northing and 80 feet on the easting, McGehee et al. identified the easternmost portion of magnetic Target 4 as correlating "with side scan sonar target 55J, a cluster of 3 or 4 acoustic targets 1-to3-feet in dimension" (2000:34). During diver investigations of Target 4 the entire area covering a 200-foot diameter was searched, including the location of sidescan sonar Target 55J. Besides swinging at 10-foot intervals the diver placed probes every five feet to ensure complete coverage of the area. While the harbor floor was relatively sterile in this area the diver did locate a sizeable piece of disarticulated iron sheeting (see Figure 33). After being recorded and photographed on the surface the debris was placed in a proper trash receptacle.

While McGehee et al. describe Target 55J as a "cluster of larger targets" (2000:32), the confidence level of this target was only rated at five. Since the confidence level of this anomaly was low and the target was not reproducible on any adjacent survey lines, it is likely that the target has either been removed, represented an environmental feature/scour marks, or was a fragment of the iron sheeting recovered near magnetic Target 4. Since no other cultural material or environmental features were observed by the diver investigating the area this target is not considered significant for the purposes of this investigation.

Target 76A

Identified as a "Large (over 10 feet) curvilinear" object by McGehee et al. (2000:32), the confidence level assigned to this anomaly was only a five (out of a possible 10). Results of the remote-sensing survey in this area identified only the buoy line and weight placed during the current investigation (Figure 41). After reviewing the sidescan sonar records the presence of Target 76A remained somewhat suspect.

Regardless of the findings from the remote-sensing refinement survey of Target 76A, the dive vessel was anchored with the buoy approximately 50 feet off the stern and a diver suited to manually survey the harbor bottom. Once on the bottom the diver reported soft sediments and a water depth of 39 feet. The diver commenced arcs at 10-foot intervals north and west of the buoy out 100 feet. At the north end of the arcs the diver noted a drop in the harbor floor into the existing navigation channel.

After surveying the entire area at and around the buoy no anomalies were identified which may represent Target 76A. As stipulated above, the non-repeatability of the anomaly coupled with active shrimp trawling activities in the area may explain the absence of this anomaly (Figure 42). During a similar survey (conducted by Coastal Environments, Inc. and Panamerican) in Galveston, Texas a number of curvilinear returns were documented by the sidescan sonar from pods of passing porpoise. It is possible that the curvilinear object represents the hard return of a porpoise (which were observed in Pascagoula Harbor during the current investigation) although this is purely speculation.

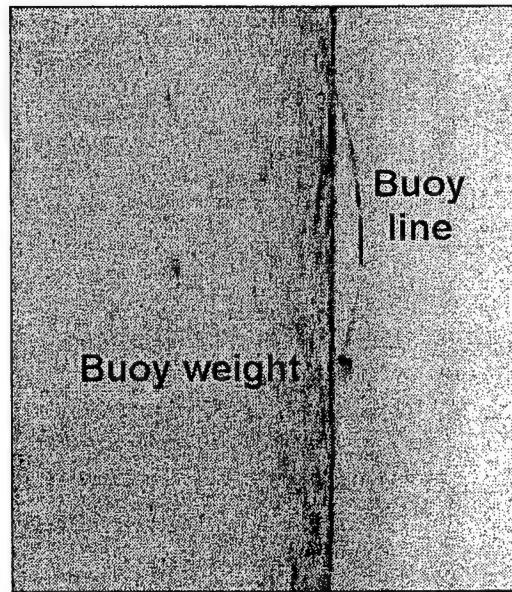


Figure 41. Sidescan sonar image of buoy line and weight on the coordinates of Target 76A.

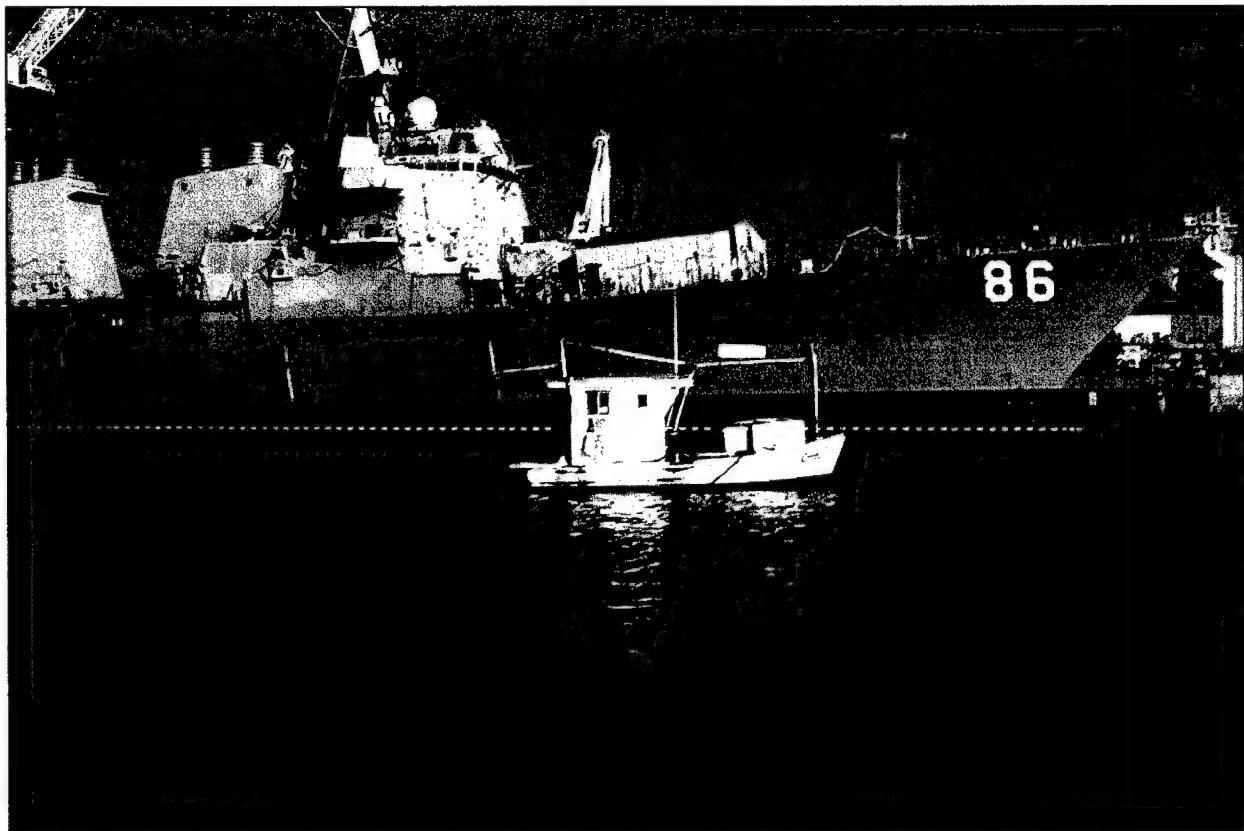


Figure 42. Local shrimp boat trawling within the project area; in background is a U.S. Naval vessel under repair at Ingalls Shipyard.

CONCLUSIONS

Panamerican conducted an intensive remote-sensing refinement survey and diver investigations of three magnetic anomalies and six sidescan sonar targets located within Pascagoula Harbor, Jackson County, Mississippi. The purpose of the survey was to determine if any of the anomalies represented potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Results from the refinement survey relocated only eight of the nine anomalies as specified by McGehee et al. (2000). Each of the eight targets relocated were identified during diver investigations. All eight targets were identified as modern debris (i.e., wire cable, 55 gallon drum, miscellaneous debris) and are not considered potentially significant submerged cultural resources.

One of the nine targets, sidescan sonar Target 76A, no longer present within its respective refinement area, was likely re-deposited to another location by trawling activities, harbor activity, or was simply an erroneous anomaly. An erroneous anomaly could include an environmental feature such as an anchor drag mark, bottom scour, or hard return from a school of fish or porpoise. Therefore, any subsequent activities concerning the proposed dredging activities of Borrow Area 2 will not impact any historically significant watercraft.

The following table represents the findings of the nine targets investigated by Panamerican during the current investigation including refined coordinates, water depth, significance, and comments.

Table 2. Refinement and Diver Investigation Results of Targets 1-9.

Target	Northing	Easting	Water Depth	Potentially Significant	Comments
4	245800	582500	25'	No	Twisted iron sheeting
5	245500	582700	24'	No	55 gal. drum/kitchen sink/small pieces of modern debris/exposed log debris
6	245800	583100	27'	No	Wire cable
22B	245580	583590	22'	No	Trawler furrow/Anchor drag
33A	245600	583610	22'	No	Trawler furrow/Anchor drag/2x6 board/15' of PVC pipe
33C	245590	583230	22'	No	Metal road sign (?) 6-8' in length
55B	245800	583550	34'	No	Exposed pieces of wire cable
55J	245820	582580	25'	No	Twisted iron sheeting
76A	246020	583510	39'	No	Not relocated

The present findings are similar to other areas where modern usage of a water body is heavy. In a study conducted in the Lower Bay Area of New York Harbor, Nowak and Riess state that the area "has been exposed to a long development history and a high degree of commercial ship traffic. One must, therefore, expect a large quantity of culturally insignificant man-made material deposited, and thus a high number of sonar targets and magnetic anomalies" (1989:30).

Comparable to the present study, a brief summary survey of results from Mobile, Matagorda, and Galveston Bays and approaches to New York Harbor, where modern commercial traffic is fairly high, follows (Bond 1986; Mistovich and Knight 1983; Pearson and Hudson 1990; Rogers et al. 1990; Tuttle and James 1996). Remote-sensing studies conducted in these areas showed that non-significant modern debris constituted the bulk of magnetic signatures located. Historic shipwrecks certainly exist in all these areas, but they can be extremely difficult to distinguish from modern debris, at least on the basis of magnetic data alone. In one survey of Mobile Bay

Bond (1986) reported that all the magnetic anomalies investigated were modern debris, much of it consisting of discarded steel cable. Mistovich and Knight (1983) also had similar findings in Mobile Bay. Pearson and Hudson (1990) reported similar findings in a remote-sensing survey of portions of the dredged navigation channel through Matagorda Bay.

Because the above nine anomalies do not represent the remains of potentially significant submerged cultural resources, it is the opinion of the principal investigator that the proposed dredging activities of portions of Pascagoula Harbor will not impact any historically significant watercraft. Further archaeological work is not recommended for the project area. If, however, any shipwreck remains are encountered during dredging operations (remains not located through electronic means or diver investigations), work in the area should cease immediately until the remains can be identified and assessed by qualified underwater archaeologists.

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APPENDIX A
DIVE LOG

Panamerican Consultants
P.O. Box 050623 Tuscaloosa, Al. 35405

Project Poccaouls
Location Shipyard Island
Vessel 53' Manners

Dive # 1
Date 1-18-01

DIVE LOG

DIVER Jim Duff
Dives in 12 Hr. Period 0

STANDBY DIVER Greg Cook
PURPOSE Relocate + Identify
Target 4 / 55J

ENVIRONMENTAL CONDITIONS:
Current
Visibility 3'
Temperature 55-60'
Bottom Type Silt
Other _____

MODE AND EQUIPMENT: SSA ; Superlite 17

Tank type K-Bottles

OTHER DIVERS DOWN:

TENDER J. Rupp / A. Lydecker
LEAVE SURFACE 12:57
RISE SURFACE 1:45
TOTAL TIME 48'
MAXIMUM DEPTH 25'

MAXIMUM PLANNED TIME AND DEPTH 30' for 120 m/y
TANK PRESSURE START 2,000 TANK PRESSURE RETURN 1,000
TOTAL AIR USED 1,000

TIMEKEEPER M. Krivor ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:

1:00 diver is swimming towards target location
1:02 diver on buoy weight - zero contact @ buoy
location; 124 depth 46' ~~in~~ south of buoy = 25'
1:32 diver has 4 ft vertical sheet metal 4' wide; loose on
the bottom. easy to move 1' tall; 3 1/2' in one direction
does not appear to be associated with any other objects
in area - 1:37 diver coming in with iron piece;
surf vertical rig @ 1:39 diver tying off iron
piece 1:45 diver on surface

Bottom PSI = 2700 psi

Panamerican Consultants
P.O. Box 050623 Tuscaloosa, Al. 35405

Project Pascagoula
Location SS # 22B & 23A
Vessel 531 manu

Dive # 2
Date 1-20-01

DIVE LOG

DIVER G. COOK

Dives in 12 Hr. Period 0

ENVIRONMENTAL CONDITIONS:

Current 0-1

Visibility 2 1/2 - 3 feet

Temperature 50'

Bottom Type Silt for 1'

Other _____

STANDBY DIVER A. Lydecker
PURPOSE Survey area for both
S.S. sonar targets

MODE AND EQUIPMENT: SSA; Superlite
17

Tank type 4-3 bottles

OTHER DIVERS DOWN:

TENDER J. Rapp / J. Duff

LEAVE SURFACE 1:27

3:23 RISE SURFACE 2:39

TOTAL TIME hr. 12 min

MAXIMUM DEPTH 22'

MAXIMUM PLANNED TIME AND DEPTH 20' for 120 min

TANK PRESSURE START 875 : 2,200 TANK PRESSURE RETURN 400 : 1,450

TOTAL AIR USED 475 + 1050 = 1525 psi

TIMEKEEPER M. Krieger

ONE-HOUR CHECKBACK OK

WORK ACCOMPLISHED AND REMARKS:

1:28 Pneumo = 27 feet 1:33 diver on T. 22B.
- no +/set @ the buoy location. \Rightarrow Cast is sweeping
C 10' intervals across bottom. Diver has noted a layer
of exposed sand - caused by shrimp drags / environmental
conditions etc. may be the source of the sidescan targets(?)
One of these features is near the target area. Diver describes
these as isolated + 5-6' in length. There is lots of
shell associated with these features 1:46: diver air switched
over 1:53 COOK south of buoys + has count of 2" x 6"
board (approx 10' south of the target(s) location. 1:54
Diver located a piece of flat plastic + trash in the
area. 2:03 pneumo north of buoys = 22 feet 2:03 diver
on a piece of PVC (?) recent in cross section but linear
15' in length. Definitely trash, non-metallic. 2:06 - diver
has found a hoop (2' in depth) - maybe a scour (?) +
is linear. The scour/drag is running east to west. Appears
1111111 to be a drag from a shrimp net. 2:22 pneumo west of
buoys = 21 feet (70' west of target location).

2:32 - Diver on T. 23A - sweeps in area produced no
associated S.S. Target.

Bail Out Psi = 7700

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Project Paccajouls
Location T. 55 5
Vessel 53' Mangers

Dive # 3
Date 1/21/01

DIVER A. Lydecker
Dives in 12 Hr. Period 0
STANDBY DIVER J. Rupp
PURPOSE Relocate + Identify T.
55b

ENVIRONMENTAL CONDITIONS:

Current 0-1
Visibility 0-3'
Temperature 50°(?)
Bottom Type Soil Silt
Other _____

MODE AND EQUIPMENT: SSA ; Superlitr
17

Tank type K. Bottles

OTHER DIVERS DOWN:

MAXIMUM PLANNED TIME AND DEPTH 30' for 100 min

TANK PRESSURE START 1,150, 2,600 TANK PRESSURE RETURN 400 : 750
TOTAL AIR USED 750 + 1,350 = 2,100

TIMEKEEPER M. Krivor ONE-HOUR CHECKBACK OK

WORK ACCOMPLISHED AND REMARKS:

12:09 Diver on bottom pressure = 26' Diver is beginning sweep north of buoy - approx. 90-100' north of buoy. Lydecker is sweeping @ 10' intervals swinging + 3' metal probe & he arcs. 12:17 diver beginning 3rd arc to the west 12:19 diver @ north end of swing + is in deep channel (mid-channel) pressure = 34' Diver is bumped up to 40' Table 12:23 diver on 4th swing - clear bottom so far 12:25 diver on 5th arc to west 12:27 diver has a layer of shell approx. 1' under the surface (will bring a piece back) 12:29 (6th arc) 12:32 diver found wire rope 3' in length 12:32 diver's air is switched over. 12:34 begin 7th swing west. 12:34 diver on smaller piece of wire cable - east of buoy: ~~10'~~ 15' in length 12:38 diver @ buoy weight. Circling area for quarry area approx. 12:47 diver swinging to the east & south of the buoy. May wire cable + plastic sheet 12:56 diver on 3rd swing east & south of buoy. 1:07 diver on last swing to the south / east swing. 1:10 Diver completing arcs @ of buoy west 1:23 Concrete block

1:07 out psi = 2,500

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Project Pascagoula
Location Target 33C
Vessel 53' Minnow

Dive # 4
Date 1/21/01

DIVE LOG

DIVER J. Rapp
Dives in 12 Hr. Period 0

STANDBY DIVER Jim Duff
PURPOSE Relocate + Identify
SS. Target 33C

ENVIRONMENTAL CONDITIONS:

Current 0-1
Visibility 4-5'
Temperature 50-52°
Bottom Type S
Other _____

MODE AND EQUIPMENT: SSA; Superlift
17

Tank type K-Bottles

OTHER DIVERS DOWN:

TENDER C. Cook / A. Lydecker
LEAVE SURFACE 2:31
RISE SURFACE 3:09
TOTAL TIME 38 min
MAXIMUM DEPTH 22'

MAXIMUM PLANNED TIME AND DEPTH

TANK PRESSURE START 2050 TANK PRESSURE RETURN 1,150
TOTAL AIR USED 900 ps

TIMEKEEPER M. Krivov ONE-HOUR CHECKBACK _____

WORK ACCOMPLISHED AND REMARKS:

2:32 - ~~pressure~~ = 22': good visibility. Diver is on
boring west of T. 33C. Diver has reported ~~the~~ intermittent
shell layers under the soft sediment. 2:42 diver has found
a metal object sticking out of the sediment. Very thin +
exposed 2' above the sediment. Square/rectangle in shape.
This is very near the Target location. It is 5-8' in length
maybe a sheet of metal; possibly pointed on one side. one
corner is rounded. Diver will continue to search target area.
2:50 diver working in east (north of T. 33C area).
3:00 - due to shifting winds the dive was cut short. ~~but~~
we are confident due to the close association of
the "sign" to the buried location that T. 33C represents
a modern piece of metal; possibly a channel marker/road
sign sticking straight up off the bottom 2 feet.

Reef out ps = 2.5"

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Project Pascagoula
Location Mrs. Target #5
Vessel SS Mazzina

Dive # E 5
Date Jan 22, '01

DIVE LOG

DIVER M. Krieger STANDBY DIVER J. Duff
Dives in 12 Hr. Period 0 PURPOSE Sweep area for magnetic targets,
use short probe in search

ENVIRONMENTAL CONDITIONS:

Current 0-1
Visibility 23'
Temperature 50°
Bottom Type silty mud 1' deep
Other _____

MODE AND EQUIPMENT: SSA: Superlite 17

Tank type K-Bottles

OTHER DIVERS DOWN:

TENDER J. Raup
LEAVE SURFACE 12:03
RISE SURFACE 12:21
TOTAL TIME 1:18
MAXIMUM DEPTH 24'

MAXIMUM PLANNED TIME AND DEPTH 30' 120 min.
TANK PRESSURE START 1,100/2100 TANK PRESSURE RETURN 400/1650
TOTAL AIR USED 1,150

TIMEKEEPER G. Cook ONE-HOUR CHECKBACK OK

WORK ACCOMPLISHED AND REMARKS: Pneumo 24'
12:04 silt 1' deep, diver begins to right (east), harder
shell layer about 1' down, 12:09 diver finds circular object, thin (NNE of buoy, 30')
sides, remains of 55 gal. drum lying on side, heavily rusted, probing, no
bubbles, 20' N. of buoy, 50' west. 12:11 found, orange, no return, no cultural
material. 12:17 diver finds buoy, cardinal probes no return.
12:23 wood debris, possibly root / tree debris, small 1' cut timber 2x3 in.,
no fasteners, probes around return negative. 12:25 finds no free wood
debris, 6" to 1' under surface. 12:27 section of log, deteriorated, exposed for
16-18 in bottom, parallel to 12:30 cylindrical object, horiz. on bottom,
possibly concrete. W end diam. 12" extends 2' to S/SW, southern end smaller
in diam. object actually wood, southern end has a 6" extension, 3" diam.,
end deteriorated, appears cultural, probes, tanks changed 12:43 more free debris
12:55 diver found flat vertical board, 1/2" thin, small piece, probing negative, 1 1/2' diam.
13:02 more wood / branches underfoot, a small 3" log, 12" long, finds a wooden debris around
it. 1:05 more wood debris underfoot, also found metal object, rounded edges,
possibly sink @ 35' east of buoy, diver returning at 1:18

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Project Discagols
Location Mis. Target #6
Vessel 53' mensa

Dive # 6
Date 1-22-01

DIVE LOG

DIVER J. Doff
Dives in 12 Hr. Period 0

STANDBY DIVER G. Cook
PURPOSE Relocate & Identif-y
Mis. Target #6

ENVIRONMENTAL CONDITIONS:
Current 0-1
Visibility 2'-3'
Temperature 50°
Bottom Type soft silt
Other _____

MODE AND EQUIPMENT: SSA; Superlite
17

Tank type K-bottles

OTHER DIVERS DOWN:

TENDER A. Lydecker / J. Recupp
LEAVE SURFACE 2:02
RISE SURFACE 3:21
TOTAL TIME 1 hr. 19 min
MAXIMUM DEPTH 26'

MAXIMUM PLANNED TIME AND DEPTH 30' for 120'
TANK PRESSURE START 2,200/1700 TANK PRESSURE RETURN 400/1600
TOTAL AIR USED 1,800 + 100 = 1,900 ps

TIMEKEEPER M. Kriovs ONE-HOUR CHECKBACK OK

WORK ACCOMPLISHED AND REMARKS:

2:03 on bottom pneum = 25' diver will probe
to 6' @ 10' intervals. 2:07 diver @ buoy weight; proceeding
to probe @ 5' intervals in cardinal directions for
any anomalies. All cardinal directions are negative returns
2:10 diver is continuing probes to the west & slightly north
2:31 diver completed west & south west of buoy. Will
now work north & east of buoy. 2:39 diver north of
buoy - clay lens 1' under the silt; Probes are being
taken @ less than 10' intervals. 2:51 diver completing
area to south east of buoy - no targets yet. 3:00 diver
returning to buoy. 3:09 pneum north of buoy = 26'
3:14 Diver has almost completed the entire working
around the buoyed location with no positive
probe hits or anomalies. 3:21 diver on surface
no positive anomaly identified during the survey.

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Project Pascagoula
Location Sidescan Target #76A
Vessel 53' man 814

Dive # 7
Date 1-23-01

DIVE LOG

DIVER A. Lybster
Dives in 12 Hr. Period 0

STANDBY DIVER G. Cook
PURPOSE Locate + ident. fr
S.S. # 76A

ENVIRONMENTAL CONDITIONS:

Current 1-2
Visibility 0-2'
Temperature 50°
Bottom Type soft silt
Other _____

MODE AND EQUIPMENT: SEA ; Superlite 17

Tank type _____

OTHER DIVERS DOWN:

TENDER J. Raupp / J. Duff
LEAVE SURFACE 1:33
RISE SURFACE 2:33
TOTAL TIME 1 hr. 5 min.
MAXIMUM DEPTH 39'

MAXIMUM PLANNED TIME AND DEPTH 30' for 100' min
TANK PRESSURE START 2,200 TANK PRESSURE RETURN 300
TOTAL AIR USED 1,900

TIMEKEEPER M. Kriuv ONE-HOUR CHECKBACK OK

WORK ACCOMPLISHED AND REMARKS:

1:36 diver on bottom @ 39' 1:40 - diver on buoy weight - 39' depth. relatively flat bottom 1:47 diver has a couple small pieces of wood located 100' east of buoyed location. Diver is swinging on 10' lines to cover the bottom of the Target area. No "coriolis" pieces found in 1:52. 2:12 diver has completed the south / east side of buoyed target; beginning to sweep west / north of S.S. Target 76A. 2:33. Area complete - no Target located.

Boilpot psi = 2,500 checked on 1-23-01

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Project Pascagoula
Location Mag Target #6 refinement
Vessel 53' Minaret

Dive # 8
Date 1-23-69

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 0

STANDBY DIVER J. Raupp
PURPOSE Probe Mag Target #6 to
10' within 100' radius

ENVIRONMENTAL CONDITIONS:

Current 0-1
Visibility 2-3'
Temperature 50°
Bottom Type Silt
Other _____

MODE AND EQUIPMENT: SSA; Superlite 17

Tank type K1 Bottles

OTHER DIVERS DOWN:

TENDER J. Duff / A. Lydick
LEAVE SURFACE 3:10
RISE SURFACE 3:31
TOTAL TIME 21'
MAXIMUM DEPTH 27'

MAXIMUM PLANNED TIME AND DEPTH

TANK PRESSURE START 1,600 TANK PRESSURE RETURN 1,050
TOTAL AIR USED 550 psi

TIMEKEEPER M. Kriov ONE-HOUR CHECKBACK _____

WORK ACCOMPLISHED AND REMARKS:

3:11 diver on bottom @ 27' pneum. beginning to probe to 10' in area north/west of refined location. Probes easy in silt to 10'. Clay layer @ 8' under the silt but easy to penetrate.
3:19 diver has wire cable snarled on bottom - following the cable out - 15' + a coupling following it out - approx 2' below the surface. 1/2" in diameter; broken pieces pneumo on wire cable = 27' i.e. not satisfied that the 25' + of wire cable represents the magnetic target #6. A piece of wire cable was retrieved to photograph.

Balout psi = 2,500